

# In the United States Court of Federal Claims

No. 96-166 C  
(Filed: March 31, 2014)

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**ZOLTEK CORPORATION,**

Plaintiff,

v.

**THE UNITED STATES,**

Defendant.

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## **OPINION AND ORDER**

This matter is before the Court following a three-day trial on the issue of validity of United States Patent Reissue No. 34,162 (the “‘162 Patent”).<sup>1</sup> During trial, the Government presented evidence which, it contends, renders the ‘162 Patent invalid under three distinct legal theories: the patent does not cover patent-eligible subject matter under 35 U.S.C. § 101, the patent is obvious under 35 U.S.C. § 103, and the patent lacks adequate written description under 35 U.S.C. § 112, ¶ 1.

As explained below, the Court is not persuaded by the Government’s subject matter argument under 35 U.S.C. § 101. The Court is, however, convinced that claims 1-22 and 33-38 (all of the claims asserted in this matter) are invalid both for obviousness under 35 U.S.C. § 103 and written description under § 112. The Court therefore directs entry of judgment in favor of the Government.

### **I. Background**

For purposes of this background, the Court will present only a very broad background of the case—both factually and procedurally. Because the Government has presented three distinct

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<sup>1</sup> The ‘162 Patent appears in the trial record as Joint Exhibit 1. For purposes of clarity, because the ‘162 Patent is referenced often in this opinion, the Court will refer to the ‘162 Patent directly. When referencing other exhibits, the Court will generally use the following short-hand: JX means Joint Exhibit Number X, PY means Plaintiff’s Exhibit Number Y, and DZ means Defendant’s Exhibit Number Z.

challenges to the validity of the '162 Patent, the Court will introduce the more detailed facts relevant to each legal theory in its discussion of those theories.

### **a. Factual Background**

Plaintiff, Zoltek Corporation (“Zoltek”), brought this patent suit on March 25, 1996. The case concerns the Government’s alleged infringement, by and through the Department of the Air Force, of the ‘162 Patent, which Zoltek owns. The factual background of this matter is set forth in numerous prior opinions. *See, e.g., Zoltek Corp. v. United States*, 86 Fed.Cl. 738, 739-42 (2009); 85 Fed.Cl. 409, 411 (2009); 71 Fed.Cl. 160, 161-64 (2006); 61 Fed.Cl. 12, 14-15 (2004); 58 Fed.Cl. 688, 689-91 (2003); 51 Fed.Cl. 829, 830-32 (2002); 48 Fed.Cl. 290, 292 (2000). These factual underpinnings are, of course, heavily supplemented by the facts derived from trial. As the case now stands, Zoltek alleges that the United States has infringed the ‘162 Patent through its development and production of the B-2 Bomber and the F-22 Raptor.

The ‘162 Patent is a reissue of United States Patent No. 4,728,395 (the “‘395 Patent”). Joint Exhibit (“J”) 1.1. The ‘395 Patent was issued on March 1, 1988 from an application filed by George Boyd on October 12, 1984. At the time of filing, Mr. Boyd was employed by Stackpole Fibers Co., Inc. Stackpole was the original assignee of the ‘395 Patent, but Zoltek acquired Stackpole in 1988 and subsequently took assignment of the ‘162 Patent.

It suffices here to say that the ‘162 Patent describes a process for manufacturing carbon fiber sheet products with controlled surface electrical resistivity. *Zoltek Corp. v. United States*, 48 Fed.Cl. 290, 292 (2000). Claim 1 is representative:

A method of manufacturing a plurality of different value controlled resistivity carbon fiber sheet products employing a carbonizable starting material; said method comprising [oxidizing and stabilizing the carbonizable fiber starting material at an elevated temperature of the order of 220 degrees Centigrade to effect aromatic rearrangement of the fibers,] selectively *partially* carbonizing [the] *previously* oxidized and stabilized fiber starting material for a predetermined period in an oxygen free atmosphere within a furnace at [a] selected temperature *values* within a temperature range from 370 degrees Centigrade to about 1300 degree Centigrade by soaking the stabilized fiber starting material at the selected temperature for the predetermined period of time to provide a [desired] *preselected known volume* electrical resistivity to the *partially* carbonized fibers *corresponding to that volume electrical resistivity value required to provide the preselected desired surface resistance value for the finished sheet products*, and thereafter processing the *partially* carbonized fibers into [desired electrical resistivity] *homogeneous* carbon fiber sheet products [having the form of non-woven paper or woven or knitted fabric sheet products] having *the* preselected desired surface electrical [resistivities] *resistances*.

‘162 Patent at 8:42-66.<sup>2</sup>

By way of this process, a manufacturer can determine the level of surface resistivity necessary for a particular application, and then create carbon fibers with that preselected level of resistivity by partially carbonizing a fiber starting material for a certain period of time at a given temperature between 370 and 1300 degrees Centigrade. 48 Fed.Cl. at 293. The fibers are then incorporated into a sheet product which takes on the resistive properties of the constituent fibers. *Id.* at 296. As this Court noted in its claim construction decision, “[t]he essence of the invention is the relation between the partial carbonization of the single carbon fiber and the electrical resistivity of the sheet product which incorporates the partially carbonized single fibers.” *Id.* Zoltek alleges that the processes used by or for the Government to produce silicon carbide fiber mats and preimpregnated materials incorporated into the F-22 and B-2 infringes the ‘162 Patent.

Specifically, Zoltek asserts claims 1-22 and 33-38 of the ‘162 Patent in this action. *See* Joint Stipulation of Fact, Witnesses and Exhibits (“Jt. Stip.”) at ¶ 2. Of these, claims 1, 11, 15 and 33 are independent claims. *See* ‘162 Patent at 8:42, 9:65, 10:35, 11:47. The rest of the asserted claims depend upon these claims. *See generally* ‘162 Patent at 8:67-11:34.

### **b. Procedural History**

As one might expect of a case approaching its third decade of proceedings, the procedural background of this matter is extensive. The Court will discuss only a few particularly relevant points in this background in order to explain the posture at trial.

In 2006, the Federal Circuit heard this case on appeal. *See Zoltek Corp. v. United States*, 442 F.3d 1345 (Fed. Cir. 2006). The result of its decision was the dismissal of the F-22 portion of the case. The B-2 portion of the case proceeded uninterrupted. However, on March 14, 2012, the Federal Circuit published another opinion in this case. *See Zoltek Corp. v. United States*, 672 F.3d 1309 (Fed. Cir. 2012). In that decision, the Federal Circuit, acting *sua sponte* and sitting *en banc* for this part of its decision only, vacated its 2006 decision in its entirety. *Id.* at 1317. The result of this decision was that Zoltek’s F-22 case was resurrected almost six years to the day after it was left for dead in this Court. The Court ordered the parties to submit a Joint Status Report addressing the practical implications of the Federal Circuit’s 2012 decision.

In their Joint Status Report, the parties disagreed over how to proceed. Zoltek wanted to complete discovery relating to the F-22 before trial, such that both the B-2 and the F-22 issues could be resolved simultaneously. *See* Joint Status Report, Docket No. 456, at 1-2. The Government believed that the Court should schedule trial on the B-2 immediately since there were no common issues between the two sets of claims. *Id.* at 2.

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<sup>2</sup> Note that the bracketed language is part of the original patent which was removed during reissue proceedings and the italicized language is language which was added during reissue proceedings. *See* ‘162 Patent at 1:5-8 (“Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.”).

On February 15, 2013, the parties submitted another status report. The parties still disagreed as to the time and form of trial, so the Court ordered the parties to submit briefs in support of their positions. The Court's order required the parties to address specific questions, the answers to which it would consider in resolving the trial scheduling conflict. *See generally* Docket No. 472. After considering the parties' positions, the Court determined that the most efficient process moving forward would be to hold trial to address the Government's assertions of invalidity first, and to return to the remaining questions afterwards, if necessary. That order led to the trial which is the subject of the instant opinion.

### **c. The Trial**

The Court presided over the trial in this matter beginning on November 4, 2013. During the trial, the Court heard testimony from the Government's expert, Dr. Brian Sullivan, and from Zoltek's CEO, Zsolt Romy, who testified both as a fact and expert witness. The Court also received, by way of deposition testimony, evidence from a number of other witnesses who are either deceased, advanced in age, or who otherwise were unable to appear live at trial. Although this opinion takes all of the admitted evidence into account, the parties' briefs make clear that Dr. Sullivan and Mr. Romy are the key witnesses in this case.

## **II. The Government's Invalidity Contentions**

As stated above, the Government has challenged the validity of the '162 Patent under three separate grounds. First, it argues that the '162 Patent claims subject matter which is ineligible for patent protection under 35 U.S.C. § 101 and Supreme Court precedent. It also argues that the '162 Patent is invalid for obviousness under 35 U.S.C. § 103. Finally, it argues that the '162 Patent is invalid under 35 U.S.C. § 112, ¶ 1, for a lack of written description. The Court will address each of these arguments in turn.

## **III. The '162 Patent Is Not Invalid Under 35 U.S.C. § 101**

The Government has asked the Court to wade into the morass that is § 101 of the Patent Act. In doing so, the Government argues that Claims 1-4, 9, 10 and 33-38 of the '162 Patent, all of which are method claims, are invalid. Unfortunately for the Government and the Court, this expedition proves fruitless as the Government has not convinced the Court that Zoltek's patent claims patent-ineligible subject matter.

"Patent eligibility under § 101 presents an issue of law," though the "legal conclusion may contain underlying factual issues." *Accenture Global Servs. V. Guidewire Software, Inc.*, 728 F.3d 1336, 1340-41 (Fed. Cir. 2013). Invalidity by way of a failure to claim patent-eligible subject matter must be proven by clear and convincing evidence. *Ultramercial, Inc. v. Hulu, LLC*, 722 F.3d 1335, 1338-39 (Fed. Cir. 2013).

Section 101 of the Patent Act states that, "[w]hoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U.S.C. § 101. The plain language of this statute belies the complexity of the

subject matter analysis which the Supreme Court has devised through a series of cases dating back to the 1970s. It is now well-established that, even if they fall squarely within the expressly-stated subjects of § 101, “laws of nature, physical phenomena, and abstract ideas” are not patent eligible. *Diamond v. Chakrabarty*, 447 U.S. 330, 309 (1980) (citing *Parker v. Flook*, 437 U.S. 584 (1978); *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972)). In order to be patent eligible, “a process that focuses upon the use of a natural law [must] also contain other elements or a combination of elements, sometimes referred to as an ‘inventive concept,’ sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the natural law itself.” *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, 132 S. Ct. 1289, 1294 (2012).

The Government argues that the claims are invalid because they embody nothing more than a law of nature. For example, the Government points to Figure 4 of the patent to support its contention. It argues that Figure 4, which charts a relationship between heat treatment temperature and surface resistance, *see* ‘162 Patent Fig. 4, demonstrates the ineligibility of the ‘162 Patent claims by showing that the claims embody nothing more than a natural law that links temperature to resistance. Relying upon the testimony of its expert, Dr. Brian Sullivan, the Government argues that the independent claims at issue (claims 1 and 33) consist of three parts: (1) the manufacture of carbon fibers using conventional carbonization equipment and techniques; (2) the manufacture of a sheet product using conventional techniques and processes; and (3) “the concept that if you control the fibers’ volume electrical resistivity it gives you the ability to control the sheet or surface resistivity of the final carbon mat product.” Gov’t Br. at 10 (quoting Tr. 163-64). The Government argues that these three parts render the ‘162 Patent’s claims similar to those found ineligible in *Flook* and *Mayo*.

Zoltek counters by relying on *Diamond v. Diehr*, 450 U.S. 175 (1981), a case in which the Supreme Court affirmed the validity of the claims before it. Zoltek argues that the ‘162 Patent looks much more like *Diehr* than any other Supreme Court decision. As such, it claims that the ‘162 Patent is eligible for patent protection and therefore not invalid under § 101.

The Court agrees with Zoltek. The Government’s comparisons to the ineligible claims in *Flook* and *Mayo* are much less apt than comparison to *Diehr*. The patent application in *Flook* described a method of updating alarm limits. As the Government observes, the method consisted of three steps: (1) measuring a process variable; (2) employing an algorithm to solve a mathematical formula for an alarm limit value; and (3) updating the alarm limit accordingly. *Flook*, 437 U.S. at 585. In essence, *Flook* amounted to a claim for a mathematical equation and some insignificant “‘post-solution’ activity”: updating an alarm limit. *See id.* at 590.

Likewise, in *Mayo*, the patent consisted of three steps: (1) an “administering” step; (2) a “determining” step; and (3) a “wherein” step. *Mayo*, 132 S. Ct. at 1297. *Mayo* actually looks a lot like *Flook*, in that two steps involved something of a calculation (the “administering” and “determining” steps) and the third step added nothing of substance. *See id.* (“[T]he ‘wherein’ clauses simply tell a doctor about the relevant natural laws, *at most adding a suggestion* that he should take those laws into account when treating his patient. That is to say, these clauses tell the relevant audience about the laws while trusting them to use those laws appropriately where they are relevant to their decisionmaking.”) (emphasis added). In essence, the “wherein” clause

in *Mayo* mirrors *Flook*'s third element embodying insignificant post-solution activity. Neither case addressed claims that actually resulted in a functional product.

These cases lie in stark contrast to the claims of the patent application in *Diehr*. In that case, the claims covered a process for curing rubber by monitoring the internal temperature of the rubber mold. *Diehr*, 450 U.S. at 177. The applicants characterized their contribution as the ability to improve rubber cure quality by constantly monitoring the temperature of the mold and updating cure time via a well-known equation (the Arrhenius equation). *Id.* at 178-79. Even though the claims revolved around the application of an equation, just as the claims in *Flook*, the Court found the claims eligible for patent protection because they “involve the transformation of an article ... into a different state or thing.” *Id.* at 184. In other words, the post-solution activity was not insignificant.

So too here, the result of the claims is a not insignificant physical change. While the claims may be directed in part to what can be reasonably characterized as a mathematical relationship (as between heat treatment temperature and surface resistance), they do something significant beyond state a law of nature: they direct application of that law to produce controlled surface resistivity carbon fiber sheet products. As such, the Court finds that the challenged claims of the ‘162 Patent cover patent eligible subject matter.

#### **IV. Claims 1-22 and 33-38 of the ‘162 Patent Are Invalid Under § 103**

The Court turns next to the Government’s argument that the ‘162 Patent is invalid as obvious under 35 U.S.C. § 103. The Court first reviews the claimed invention and prior art references relevant to the parties’ arguments.

##### **a. The Claimed Invention**

The ‘162 Patent discloses methods for manufacturing controlled surface resistance carbon fiber sheet products. As this Court has previously stated: “The essence of the invention is the relation between the partial carbonization of the single carbon fiber and the electrical resistivity of the sheet product which incorporates the partially carbonized single fibers.” *Zoltek Corp. v. United States*, 48 Fed.Cl. 290, 296 (2000). The Government argues that claims 1 through 22 and 33 through 38, all of the claims still asserted by Zoltek in this case, are invalid as obvious.

Two figures from the ‘162 Patent are particularly relevant to the Government’s theory. The first, Fig. 3 of the ‘162 Patent, is a plot of electrical resistivity of a single carbon fiber as a function of heat treatment temperature. The second, Fig. 4, plots both the resistivity of the carbon fiber and the surface resistance of a sheet product made in accord with the patented method as functions of heat treatment temperature. Both Figures demonstrate a decrease in resistivity/resistance as heat treatment temperature increases.

##### **b. Prior Art References**

To qualify as prior art for the obviousness analysis, “a reference must qualify as ‘analogous art,’ i.e., it must satisfy one of the following conditions: (1) the reference must be

from the same field of endeavor; or (2) the reference must be reasonably pertinent to the problem with which the inventor is involved.” *K-TEC, Inc. v. Vita-Mix Corp.*, 696 F.3d 1364, 1375 (Fed. Cir. 2012). “A reference is reasonably pertinent if it, as a result of its subject matter, ‘logically would have commended itself to an inventor’s attention in considering his problem.’” *Id.* (quoting *Innovention Toys, LLC v. MGA Entm’t Inc.*, 637 F.3d 1314, 1321 (Fed. Cir. 2011)). Whether a prior art reference is “analogous” is a question of fact. *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1237 (Fed. Cir. 2010).

In arguing that the ‘162 Patent is obvious, the Government relies upon a series of prior art references. Zoltek challenges the Government’s reliance upon several of these references based on a few different theories. Before turning to Zoltek’s arguments, the Court briefly summarizes the references<sup>3</sup> upon which the Government relies in its post-trial brief:

- (1) *Shindo* (J101): The Shindo Report (“Shindo”) comprises a research report published in December of 1961. It discusses the manufacture and use of carbon fibers using polyacrylonitrile as a starting material. Tr. at 75-76. Dr. Sullivan testified at trial that Shindo disclosed the same relationship that is shown in Fig. 3 of the ‘162 Patent, i.e., that increasing heat treatment temperatures results in decreased volume resistivity (or increased conductivity) of the carbon fibers. See J101.40; Tr. 76-77. Shindo also discloses that other material properties, like Young’s Modulus, which likewise change based on a fiber’s heat treatment temperature. J101.28. Dr. Sullivan explained at trial that these changes in material properties—Young’s Modulus and volume resistivity—are the result of the predictable increase in crystallinity in the system. See Tr. at 78 (“This is, for my purposes, one of the most important graphs in this report, because it explains why all these other properties are changing with heat treatment temperature, simply because the graphite crystallites themselves are growing and becoming more well ordered.”) (discussing the graph on J101.33).
- (2) *Kitago* (J111): The Kitago reference is United States Patent No. 3,998,689, which issued on December 21, 1976. Kitago discloses a process for producing carbon fiber paper. The disclosed process uses short carbon fibers combined with other ingredients to form a slurry, which is then treated at a predetermined heat temperature to form a final conductive paper product. See J111.3-111.4; Jt. Stip. ¶¶ 56-58. According to Dr. Sullivan, “this patent is relative [sic] in that a very similar process was used here to create the carbon fiber sheet product, as [is used in the ‘162 Patent]. Differences are that the Zoltek paper used chopped fiber filaments that had already been heat-treated and carbonized at high temperatures, whereas the Kitago and Yoshida patent performed the heat treatment on the carbon fiber paper subsequent to its formation.” Tr. at 80. Dr. Sullivan highlighted a table in Kitago which contains data for certain physical properties of the sheet product produced via the patented method at two different heat treatment temperatures: 1000°C and 2000°C. Tr. at 80-

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<sup>3</sup> For ease of reference, the Court refers to the prior art references by the author’s name or authors’ names. In effect, the Court adopts the nomenclature used by the parties throughout this litigation, rather than the exhibit numbers used for trial purposes.

81 (referencing J111.5). The table shows a significantly lower resistance for treatment at the higher temperature. See J111.5 Table 4.

- (3) *Layden* (J109): The Layden reference is United States Patent No. 4,080,413, which issued on March 21, 1978. Layden discloses a process for producing an electrically conductive carbon fiber sheet product that, according to Dr. Sullivan, is very similar to the process disclosed in the '162 Patent. Tr. 84 (“The patent is relative – is relevant in that a very similar process was used in the Layden patent as was used in the [‘162 Patent] to create the carbon sheet product.”). Dr. Sullivan also explained that Layden demonstrates that there was a desire to control the resistivity of the material by means of different heat treatment temperatures. Tr. 84-85; Jt. Stip. ¶¶ 59-64.
- (4) *Topchjiev* (J4): The Topchjiev reference is a United Kingdom patent published in 1965. Dr. Sullivan testified that this patent discusses a method of producing carbon sheet products from oxidized and stabilized carbon fibers that are subsequently heat-treated. Tr. at 86; see also Jt. Stip. ¶¶ 73-75. According to Dr. Sullivan, Topchjiev demonstrates a desire to control electrical conductivity of the carbon sheet product. Tr. at 86-88. He also explained the simple mathematical relationship between conductivity and resistivity. Tr. at 88.
- (5) *Fischbach and Komaki* (J120): The Fischbach and Komaki reference is an article entitled “Electrical Resistance of Carbon Fibers,” which was published in 1979. J120.1. Fischbach and Komaki explains the change in resistivity of various precursor fibers as heat treatment temperature changes. Tr. 88-92; see also Jt. Stip. ¶¶ 65-66. Dr. Sullivan testified that this reference discloses the same trend as in Fig. 3 of the '162 Patent; specifically, that increasing heat treatment temperature results in a decreased volume electrical resistivity of the carbon fibers. Tr. 89. Dr. Sullivan also testified that, even though the chart in Fischbach and Komaki was only directed to the resistivity of individual carbon fibers, the same relationship would hold true for a sheet product made of the fibers and other constituent parts. Tr. 91.
- (6) The Rule of Mixtures: Dr. Sullivan described the “Rule of Mixtures” in his testimony:

The rule of mixtures basically states that if you know the relative volume fractions of all the constituents that make up a composite and you know the property of the individual constituents, you're able to predict what the property of the composite is on the basis of the constituents' fiber volume fractions and individual properties.

Tr. 113. He explained that a “volume fraction” is the percentage, by volume, of the specific material within the composite. Tr. 114-15. Dr. Sullivan referred to five different prior art references authored by Hashin<sup>4</sup>, Rosen and Christensen, each of

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<sup>4</sup> The Court notes that the table of joint exhibits provided by the parties misspells the name of the author, Hashin, as “Hashim.” In its brief, Zoltek likewise repeatedly misspells Hashin's name.



which disclosed the use of the Rule of Mixtures to determine composite properties, including electrical conduction. *See* Tr. 115-26 (discussing D49, J8, J10, J9 and J5); *see also* Jt. Stip. ¶ 68; J8 (“Hashin Report”); Jt. Stip. ¶ 69; J10 (“Rosen Article”), Jt. Stip. ¶ 70; J9 (“Hashin Survey”), Jt. Stip. ¶ 71; J5 (college textbook by Christensen, entitled “Mechanics of Composite Materials” (“Christensen”)); Jt. Stip. ¶ 67.

- (7) Admissions of the patentee, inventor or applicant: The Government also notes that “[a]dmissions in the specification regarding the prior art are binding on the patentee for purposes of a later inquiry into obviousness.” *PharmaStem Therapeutics, Inc. v. Viacell, Inc.*, 491 F.3d 1342, 1362 (Fed. Cir. 2007); *see also Smith & Nephew, Inc. v. Rea*, 721 F.3d 1371, 1380 n.5 (Fed. Cir. 2013) (“Expert opinions that are contrary to admissions in the specification do not create a factual issue.”) (citing *PharmaStem*, 491 F.3d at 1361-62). Admissions and statements made during prosecution of a patent also constitute binding admissions as to the scope of prior art. *See Springs Window Fashions LP v. Novo Indus., L.P.*, 323 F.3d 989, 995 (Fed. Cir. 2003) (“The public notice function of a patent and its prosecution history requires that a patentee be held to what he declares during the prosecution of his patent.”).

Dr. Sullivan explained that the ‘162 Patent states that conventional paper-making equipment could be used to perform the paper making steps as claimed in the ‘162 Patent. *See* Tr. 69-70; *see also* Jt. Stip. ¶ 55. The ‘162 Patent also admits that it was known prior to the filing date that volume resistivity of the final fiber decreases as a heat treatment temperature increases. *See* Tr. 72 (referring to ‘162 Patent 5:38-49).

During prosecution, the applicant stated that the patentably distinguishing feature of the disclosed invention was the ability to control the sheet resistivity by carbonizing at a selected temperature within the range of 370 degrees to 1250 degrees Centigrade. *See* J3.164; *see also* J3.142. These admissions were mirrored at trial by Zoltek’s CEO, Zsolt Rummy. *See* Tr. 342 (admitting that methods of making carbon fibers and carbon fiber paper products were known in 1984); *see also* Tr. 343 (admitting that the “uniqueness” of the processes sought to be patented rested in the “coordination of the heat treatment temperature of a fiber in order to get the ... surface resistance ... in the product.”).

The Court finds, in light of Dr. Sullivan’s testimony, that all of these references constitute analogous prior art. To the extent that the references discuss controlling resistivity of carbon fibers, they are plainly analogous to part of the method described in the ‘162 Patent. The same can be said for the references discussing the change in resistivity based on heat treatment temperature. Even the references discussing conductivity, like Shindo and Topchjiev, would be relevant because, as explained by Dr. Sullivan, a person of ordinary skill in the art would understand the mathematical relationship between conductivity and resistivity. *See* Tr. 88.

Zoltek argues that Topchjiev, Layden and Fischbach and Komaki are not directed to *surface resistivity*, and the Court presumes that the unwritten point is that they instead refer to volume resistivity of the precursor fiber or of the final sheet product. However, as Dr. Sullivan testified at trial, a person of ordinary skill in the art would understand how to calculate surface

resistivity from sheet volume resistivity: surface resistivity is simply the volume resistivity of the sheet divided by the sheet thickness. Tr. 107-08. Zoltek offered no evidence to contradict Dr. Sullivan's proposed relationship between volume and surface resistivities; as such, the Court accepts Dr. Sullivan's testimony as true and accurate. Dr. Sullivan's testimony convinced the Court that a person of ordinary skill would understand the relationship between these two values and, therefore, would not limit his research only to surface resistivity but would also consider sources that discuss volume resistivity.

Zoltek's challenge to Dr. Sullivan's use of the Rule of Mixtures is a better argument, but again, Zoltek's arguments do not give the Court reason to doubt Dr. Sullivan's application of the Rule of Mixtures. First, Zoltek argues that the Hashin Report does not discuss carbon fiber composites or their electrical characteristics. Next, it argues that the Rosen Article is directed to fully carbonized carbon fibers, not partially carbonized fibers. Finally, Zoltek argues that the Hashin Survey and Christensen does not mention surface resistivities, partially carbonized fibers, or controlling surface resistivity of carbon fiber sheet products by way of volume resistivity of individual carbon fibers.

Zoltek completely misses the point of Dr. Sullivan's reliance on these references. They are not directed to the specifics of carbon fibers or controlling resistivity. Dr. Sullivan applied these references to explain how, in the field of composite materials, if one knows the relevant characteristic (i.e., resistivity) of the components and their volume fractions, one can calculate with reasonable certainty the relevant characteristic of the composite material comprised of those components. To this end, the Court finds the Rule of Mixtures relevant because, by Zoltek's own characterization at trial, the sheet products produced in accord with the '162 Patent are composite materials. *See* Tr. 21 (Zoltek, in its opening statement, explained that, "[i]n contrast to Dr. Sullivan, Zsolt Rummy and Lee McKague have a combined more than 80 years of experience in the actual manufacture of carbon fiber *composite* products.") (emphasis added).

In sum, the Court concludes that all of the references cited by the Government are, at the very least, analogous art. If a person skilled in the art sought to produce a carbon fiber composite material with controlled surface resistivity, that person would almost certainly look at how to control the resistivity of the carbon fiber starting material, how to manufacture a composite sheet product from the carbon fiber starting material, and how to determine a composite material's overall characteristics based on the characteristics of its components.

### **c. Obviousness Standards**

A patent is invalid if it is obvious. 35 U.S.C. § 103. Section 103 provides that a patent may not be obtained "if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains." *Id.*; *see KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). In reaching its determination, a court must avoid the use of hindsight or "*ex post* reasoning." *KSR*, 550 U.S. at 421; *see also Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 36 (1966).

Obviousness can be demonstrated where modifications to a single prior art reference would have been obvious, *see, e.g., Takeda Chem. Indus., Ltd. V. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1357 (Fed. Cir. 2007), or where it would have been obvious to combine multiple elements of various pieces of prior art. *See KSR*, 550 U.S. at 417. The mere fact, however, that prior art could have been modified to achieve the patent-in-suit at the time of the invention does not render the invention invalid on the grounds of obviousness, “unless the prior art suggests the desirability of the modification.” *Cordis Corp. v. Medtronic Ave, Inc.*, 511 F.3d 1157, 1172 (Fed. Cir. 2008). “Obviousness is a question of law based on underlying findings of fact.” *In re Kubin*, 561 F.3d 1351, 1355 (Fed. Cir. 2009); *see also Rolls-Royce, PLC v. United Techs. Corp.*, 603 F.3d 1325, 1338 (Fed. Cir. 2010) (“obviousness is a question of law based on underlying factual inquiries”).

### **i. The *Graham* Factual Inquiries**

In *Graham*, the Supreme Court set out the factual inquiries for the determination of patent invalidity based on obviousness. These inquiries, known as the *Graham* factors, govern whether the claimed invention is obvious and, therefore, the patent invalid under § 103. These factors include (1) the level of ordinary skill in the art; (2) the scope and content of the prior art; and (3) the differences between the prior art and the claimed invention. *KSR*, 550 U.S. at 406 (quoting *Graham*, 383 U.S. at 17-18). Under this framework, “the obviousness or non-obviousness of the subject matter is determined.” *Graham*, 383 U.S. at 17.

*Graham* also requires consideration of secondary indicia (frequently called considerations) of non-obviousness, such as “commercial success, long felt but unsolved needs, [or the] failure or others” to achieve comparable results. *Id.* at 17-18. Since *Graham*, courts have also considered skepticism or disbelief, copying or praise of the claimed invention, and unexpected results as secondary considerations of non-obviousness. *Brown & Williamson Tobacco Corp. v. Philip Morris, Inc.*, 229 F.3d 1120, 1129 (Fed. Cir. 2000).

### **ii. Reason to Combine Prior Art References**

When an innovation is alleged to be obvious in light of the combination of two or more prior art references, “it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.” *KSR*, 550 U.S. at 418. In *KSR*, the Court held that a patent is invalid if “[t]he combination of familiar elements according to known methods is likely to be obvious when it does not more than yield predictable results.” *Id.* at 416. As the Court noted,

Often, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent.

*Id.* at 418.

The *KSR* Court also held that a patent may be obvious in light of a combination of prior art references if the combination was “obvious to try.” *Id.* at 421. “When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp.” *Id.* Whether a solution is predictable is determined in part by whether a person of ordinary skill in the art would have had a reasonable expectation of success. *Life Techs., Inc. v. Clontech Labs., Inc.*, 224 F.3d 1320, 1326 (Fed. Cir. 2000) (“Reasonable expectation of success is assessed from the perspective of the person of ordinary skill in the art.”).

Naturally, some fields of technological art are less predictable than others. “[T]o the extent an art is unpredictable, as the chemical arts often are, *KSR*’s focus on ... ‘identified, predictable solutions’ may present a difficult hurdle because potential solutions are less likely to be genuinely predictable.” *Procter & Gamble Co. v. Teva Pharmaceuticals USA, Inc.*, 566 F.3d 989, 996 (Fed. Cir. 2009).

#### **d. Discussion**

Before turning to the issues disputed by the parties, the Court first discusses the level of ordinary skill in the art, which is not in dispute. The Court will then discuss the remaining *Graham* factors.

##### **i. The Level of Ordinary Skill in the Art**

It has been settled since 2000 that the parties agree on the level of ordinary skill in the art.

The parties agree that one skilled in the art would have at least a bachelor’s degree in chemical engineering or chemistry. One skilled in the art would also have a working knowledge of the characteristics and uses of cellulosic, pitch and acrylic carbon fiber precursors, the characteristics of carbon fiber, the pyrolyzation processes used in making carbon fiber and processes for making carbon fiber sheet products.

*Zoltek Corp. v. United States*, 48 Fed.Cl. 290, 293 n.1 (2000); Jt. Stip. ¶ 135.

##### **ii. The Government Has Made Out a Prima Facie Case of Obviousness**

The parties have presented numerous arguments with respect to obviousness. Because the Government’s theory rests heavily on Dr. Sullivan’s testimony and *Zoltek* directly challenges much of Dr. Sullivan’s testimony, the Court first addresses those challenges which cannot readily be linked to a specific substantive question. It then turns to the parties’ substantive dispute.

## **1. Zoltek's Challenges to Dr. Sullivan's Testimony are Unpersuasive**

Zoltek first argues that Dr. Sullivan's educational and work experience did not involve the production of carbon fibers or carbon fiber sheet products having specified electrical characteristics. This is essentially a retread of the very same argument the Court rejected in its summary judgment opinion, which also addressed the parties' motions to strike the other party's expert. Specifically, the Court noted in that opinion that Zoltek argued that Dr. Sullivan was unqualified to testify in this case "given the absence of any work involving electrical properties of carbon fibers." *See Zoltek*, 95 Fed.Cl. at 685. The Court rejected this theory because, in its view, it mirrored an argument rejected in *Raytheon Co. v. United States*, Civ. No. 05-448, 2009 WL 1373959, at \* 1 (Fed.Cl. May 13, 2009). The Court sees nothing in Zoltek's renewed argument that would cause it to reconsider its previous ruling.

Zoltek's argument could perhaps be characterized as an attempt to cast doubt upon Dr. Sullivan's testimony. To this end, the Court notes that it found Dr. Sullivan's testimony credible. To the extent that this is Zoltek's intended purpose with its argument, it is rejected.

Zoltek next challenges Dr. Sullivan's testimony because his mathematical model, whereby he demonstrated that the '162 Patent could be reproduced by a combination of well-known mathematical equations and the prior art, has never been used by any manufacturer. It is unclear for precisely what purpose Zoltek raises this issue, but to the extent that Zoltek raises it to counter the Government's prima facie case of obviousness, Zoltek has cited no cases to explain the relevance. To the extent that Zoltek intends this argument to apply to its secondary considerations position, the Court addresses those considerations below.

The remainder of Zoltek's challenges to Dr. Sullivan's can be logically linked to the substantive arguments before the Court, so they will be addressed where most appropriate.

## **2. The *Graham* Factors**

The Government's argument for obviousness is clear and concise. Zoltek's opposing argument, on the other hand, can best be characterized as scattershot. Rather than chasing each rabbit down its hole, the Court organizes its discussion in as direct a manner as possible.

The Government argues that Dr. Sullivan's testimony establishes the obviousness of the '162 Patent. At trial, Dr. Sullivan testified that the steps embodied in claims 1-22 and 33-38 can be divided into three categories: (1) steps for processing the carbon fibers themselves by oxidizing and stabilizing them then performing carbonization and heat treatment; (2) steps for producing carbon fiber paper or carbon sheet products; and (3) controlling surface resistivity of the sheet product by means of controlling the heat treatment temperature. Tr. 163-64. Dr. Sullivan then testified as to how the various prior art references map onto these categories.

Dr. Sullivan testified that both Shindo and Fischbach and Komaki were relevant to Category 1. Tr. 101-02. He testified that these references demonstrate the relationship between the "starting material and heat treatment temperature and the resulting carbon fiber properties."

Tr. 102. The Government also observes that the '162 Patent itself acknowledges that the change in resistivity of single fibers based upon heat treatment was known at the time of filing. *See* '162 Patent at 5:38-49; Jt. Stip. ¶ 6. On the basis of these facts, Dr. Sullivan opined that Category 1 was "clearly within the state of the art." Tr. 166. Because all of the sources relied upon by Dr. Sullivan predate 1983, they qualify as prior art for purposes of obviousness. This conclusion is bolstered by Mr. Rummy's testimony at trial, wherein he admitted that he believed similar methods of making carbon fibers were well known prior to the filing date of the patent. Tr. 342.

Category 2, the processes for making sheet products such as paper, was also known in the art. Not only does the '162 Patent itself cite a textbook on making paper, *see* '162 Patent 6:28-35, but Dr. Sullivan testified that Topchjiev, Kitago and Layden all describe production of carbon paper sheet products. Tr. 167. Based on these references, Dr. Sullivan opined that Category 2 was the state of the art prior to 1984. Tr. 166-67. Once again, Mr. Rummy also testified that processes for making carbon fiber paper products were known prior to the filing of the patent application. Tr. 342-43.

Category 3, the correlation between carbonization temperature and surface resistivity of the final sheet product, is really the meat of the '162 Patent's claim of novelty. Dr. Sullivan explained that the prior art references relevant to this category are Layden, Topchjiev and the Rule of Mixtures references. At trial, he explained that, prior to 1984:

There was a desire to control electrical conductivity, to control volume resistivity, and to control surface resistivity. They're all related quantities. Simple expressions allow you to know how the conductivity is related to the volume resistivity and how the volume resistivity is related to the surface resistivity. Very simple algebraic equations.

Tr. 105-06. He then demonstrated the application of these equations. *See* D85. He also demonstrated the application of the Rule of Mixtures. Tr. 114-15 (producing D86).

Combining the calculations for resistivity/conductivity and the Rules of Mixtures, Dr. Sullivan explained that, in order to calculate surface resistivity for a sheet product, in light of the prior art, a person of ordinary skill in the art would need only to know the fiber's volume resistivity, the fiber's volume fraction within the composite, the fiber orientations, and the final thickness of the product. Tr. 145-46. He applied this calculation in a spreadsheet, *see* D80, and plotted the results. The degree of similarity between his calculated values and the data reflected in Fig. 4 of the '162 Patent is striking. *Compare* D80.1 *with* '162 Patent Fig. 4.

Zoltek argues that Dr. Sullivan's calculations are materially deficient because he used incorrect values for various parts of his calculations. First, Zoltek notes that the '162 Patent states that the density of the carbonized and stabilized fibers (i.e., the density after stabilization and oxidation but prior to heat treatment) is about 1.36 g/cm<sup>3</sup>, while Dr. Sullivan's calculations used a density of 1.81 g/cm<sup>3</sup>. *Compare* '162 Patent 4:51-52 (stating that the starting material has "a density of about 1.36 grams per cubic centimeter."), *with* D80.2 (using 1.81 g/cm<sup>3</sup> as the density). However, Dr. Sullivan explained that the density of the fiber would increase with heat treatment temperature, and the Court notes that the graph produced by Dr. Sullivan is actually

more accurate at higher temperatures, which supports his thesis that density increases with heat treatment temperature. Because Dr. Sullivan's calculation method is a fact for purposes of this litigation, the Court recalculated the surface resistivity using the  $1.36 \text{ g/cm}^3$  value at 775 degrees Centigrade, which is the lowest temperature in Dr. Sullivan's chart, and it actually results in a closer approximation to the measured sheet resistivity than the  $1.81 \text{ g/cm}^3$  value.<sup>5</sup> Thus, it seems to the Court that the correct density value, which changes at different temperatures, did not substantially alter Dr. Sullivan's calculations.

The other value Zoltek challenges is Dr. Sullivan's use of .3 as the fiber volume fraction in his calculations. This challenge made for an interesting series of events at trial. It was first raised on Zoltek's cross-examination of Dr. Sullivan, during which Dr. Sullivan testified that he selected the .3 (30%) value based on his experience that fiber volume fractions typically range from 20% to 35%. Tr. 260-61. Zoltek's counsel then asked Dr. Sullivan if he would be surprised to learn that the volume fraction is actually closer to .03 (3%). Tr. at 263 ("Would you be surprised to learn that the estimated fiber volume fraction in the Zoltek sheet product described in the Zoltek patent is 0.03?"). On direct examination, Mr. Rummy then testified that Zoltek used a fiber volume fraction of 2.5-3%. The Government, on cross, then asked Mr. Rummy about Joint Exhibit 37, a Stackpole document from 1984. The document showed fiber volume fractions on the order of 15-30%. See J37.9. Mr. Rummy testified that the document did not refer to the process described in the '162 Patent. Tr. 366-67. The Court finds this testimony not credible because the document contains a flowchart that is virtually identical to Figure 1 of the '162 Patent. Compare J37.3, with '162 Patent at Fig. 1. In light of J37 and Zoltek's failure to offer any credible evidence to the contrary, the Court finds that Dr. Sullivan's .3 value was reasonable in light of his experience and the Stackpole document. Even though Dr. Sullivan did not testify that he relied upon J37 in using the .3 value, the document corroborates his selection of .3 based on his experience and lends further credence to his testimony.

In sum, the Government, by way of Dr. Sullivan's testimony and the trial record, has established that all the elements of claims 1-22 and 33-38 were present in the prior art. With this point established, the Court turns to the question of whether the Government has established that there was a reason to combine the references.

### **3. The Government Has Established a Motivation to Combine the Prior Art References**

In looking to the reason to combine, *KSR* rejected a rigid approach to the obviousness inquiry. See *KSR*, 550 U.S. 415-22. Instead, the Supreme Court "required an analysis that reads the prior art in context, taking account of 'demands known to the design community,' 'the

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<sup>5</sup> According to D80.2, Dr. Sullivan calculated a surface resistivity of 3390 ohm/sq and the measured resistivity was 2290 ohm/sq. Applying the  $1.36 \text{ g/cm}^3$  value, the Court obtained a calculated surface resistivity of 3087.85 ohm/sq. It should be noted that the calculation at 775 degrees Centigrade is the least accurate calculation on Dr. Sullivan's chart. Thus, it would seem that if Dr. Sullivan was provided with the actual fiber densities—which values Zoltek did not provide him throughout the extensive history of this litigation—his calculations would likely prove even more accurate than they already are.

background knowledge possessed by a person having ordinary skill in the art,’ and ‘the inferences and creative steps that a person of ordinary skill in the art would employ.” *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013) (quoting *KSR*, 550 U.S. at 418). Such an inquiry “not only permits, but *requires*, consideration of common knowledge and common sense.” *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1367 (Fed. Cir. 2006) (emphasis in original).

There are really two issues raised in Zoltek’s brief with respect to the motivation element. First, Zoltek argues that Dr. Sullivan has simply not explained why someone would combine the prior art references in the manner he explained. Second, Zoltek highlights Dr. Sullivan’s inability to point to a single entity which applied his mathematic calculations in commercial practice. The Government argues that Dr. Sullivan’s testimony speaks for itself; he clearly explained why he thought a person of ordinary skill would seek to combine the references.

The first argument simply ignores Dr. Sullivan’s clear testimony at trial. Contrary to Zoltek’s assertion, Dr. Sullivan stated his opinion that, based on the teachings of Layden and Topchjiev, there was a desire to control electrical conductivity, volume resistivity, and surface resistivity in carbon fiber sheet products. *See* Tr. 105-06. This reliance upon the prior art itself is in accord with the Federal Circuit’s flexible post-*KSR* approach to obviousness: “One form of evidence to provide such a foundation [to support a party’s claim of obviousness], perhaps the most reliable because not litigation-generated, is documentary evidence consisting of prior art in the area.” *Randall*, 733 F.3d at 1362-63. Similar to the common-sense approach applied in *Randall*, Dr. Sullivan explained that the prior art demonstrated that heat treatment temperature had an effect on both volume resistivity of carbon fibers and on carbon sheet resistivity.

Recalling Dr. Sullivan’s explanation of the prior art,<sup>6</sup> the evidence strongly supports the notion that the method claimed in the ‘162 Patent is nothing more than an extension of the phenomenon observed in the prior art. Whereas the prior art recognized that there was a relationship between heat treatment temperature and resistivity, each reference only presented a couple of data points. After seeing this relationship in several references, a person of ordinary skill and with a modicum of common sense and creativity would certainly have seen reason to test the relationship across a broader range of temperatures. *See Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1329 (Fed. Cir. 2009) (explaining that “the sources of information for a properly flexible obviousness inquiry include... ‘any need or problem known in the field of endeavor at the time of invention and addressed by the patent’”) (citing *KSR*, 550 U.S. at 418-21).

Dr. Sullivan also explained the motivation behind the application of the Rule of Mixtures in this case. He explained that his mathematical model would have been desirable to anyone producing sheet products to minimize the costs of expensive trial and error. Tr. 157-61. This cost-saving benefit is exactly the type of design incentive or market force the Supreme Court highlighted in *KSR*. *See KSR*, 550 U.S. at 401 (“When a work is available in one field, design

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<sup>6</sup> Dr. Sullivan explained that Shindo and Fischbach and Komaki demonstrated the temperature-resistivity relationship of carbon fibers, while Kitago, Layden and Topchjiev demonstrated the same relationship in carbon fiber sheet products. *See supra*.



incentives and other market forces can prompt variations of it, either in the same field or another.”).

The only question remaining is whether the ‘162 Patent comprises predictable art. *See KSR*, 550 U.S. at 421 (emphasizing predictability as a concern in the obviousness inquiry). “[T]o the extent an art is unpredictable, as the chemical arts often are, *KSR*’s focus on . . . identified, predictable solutions may present a difficult hurdle because potential solutions are less likely to be genuinely predictable.”). *Procter & Gamble Co. v. Teva Pharmaceuticals USA, Inc.*, 566 F.3d 989, 996 (Fed. Cir. 2009) (internal quotations and citations omitted). Zoltek argues that the ‘162 Patent is not predictable because it is in the field of organic chemistry, but it offers no other explanation or evidence of unpredictability. Meanwhile, Dr. Sullivan’s calculations produced such an accurate representation of Zoltek’s experimental data that the Court can only conclude that, at least with respect to the technology described in the ‘162 Patent, the art was plainly predictable.

Zoltek also attempts to argue against the reasons for combining by noting that Dr. Sullivan was unable to cite any company that applied his mathematical method. This argument is unpersuasive for two reasons. First, Zoltek has not cited any case that necessitates commercial application for obviousness-type invalidity. Second, a reason for the lack of commercial application may be derived from Mr. Rummy’s own testimony: Zoltek never made any large-scale sales of the products made by way of the ‘162 Patent and Zoltek stopped marketing its partially-carbonized fibers shortly after the company acquired Stackpole. Tr. at 376-77 (Mr. Rummy testifying that, “right around the time I acquired the company, we were still interested in that business [producing controlled resistivity carbon fiber products], and we did some [marketing] until we realized we were not going to get any of it.”). Simply put, it appears likely that nobody performed the kind of mathematical calculations described by Dr. Sullivan because the product was not particularly effective or desirable.

### iii. Secondary Considerations

Any assessment of obviousness also requires review of existing secondary considerations of non-obviousness. *See Zoltek Corp. v. United States*, 86 Fed.Cl. 738, 746 (2009) (“It is well-settled that, if present, a Court must consider evidence of secondary indicia of non-obviousness.”). The question is generally whether the evidence of the secondary considerations is strong enough to overcome a showing of obviousness. *See, e.g., Asyst Techs., Inc. v. Emtrak, Inc.*, 544 F.3d 1310, 1316 (Fed. Cir. 2008) (“evidence of secondary considerations does not always overcome a strong prima facie showing of obviousness”).

Evidence of secondary considerations may support a finding of non-obviousness or raise doubt as to the obviousness of the patented claims. The strength of the evidence depends upon the nexus between the claimed invention and the secondary consideration. *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1343, 1352 (Fed. Cir. 2010). The patentee must provide, for example, “probative evidence that the claimed and novel features met a long-felt but unresolved need” or evidence that shows that the praise of the patented invention or failure of others is a result of the claimed invention. *Id.* at 1313. Because this evidence of secondary considerations is intended to

rebut the Government's prima facie showing of obviousness, Zoltek bears the burden of producing this evidence.

In Zoltek's pre-trial brief, it raised two sources of evidence for the Court's secondary considerations analysis: a letter written by George Rodgers, a materials engineer at Northrop Grumman Corporation ("Northrop") (J3.191) (hereinafter, "Rodgers Letter"), and a 1982 article by Quick and Mate. The trial record includes two articles by Quick and Mate (J40 and J118), both published in 1982, so it is unclear to which publication Zoltek is referring in its pre-trial brief. The point is irrelevant, however, because Zoltek did not mention either article in its post-trial brief. Accordingly, the Court assumes Zoltek has abandoned this argument. This leaves the Rodgers Letter as Zoltek's only evidence of secondary considerations.

The Rodgers Letter is part of the prosecution history of the original '395 Patent. It is dated August 6, 1987, and addressed from Mr. Rodgers to Jerry Fleming, then a Stackpole employee. J3.191. The letter, in its entirety, reads:

In December 1983, the Materials & Processes Department of Northrop Advanced Systems Division ordered four rolls of carbon fiber paper from Stackpole Fibers Co. The product was unique in that the carbon fibers were not fully carbonized, increasing the volume resistivity of the fiber which in turn increases the surface resistivity of the paper. Northrop purchased four different levels of resistivity ranging from 24 to 3000 ohms/square. At the time the order was placed, Northrop Materials & Processes had never seen a material of this type before and was not aware of any other company that could supply material in this form with varying electrical properties.

J3.191. Zoltek argues that this letter and Mr. Rodgers' deposition testimony support the validity of the '162 Patent, while the Government argues, in short, that the letter is irrelevant.

Zoltek does not clearly state what secondary consideration the Rodgers Letter is intended to address, but the Court divines that it is intended to represent industry praise. In its pre-trial brief, for example, Zoltek asserts that the Rodgers Letter "corroborat[es] the unexpected and extraordinary properties of the product produced by the Zoltek patent." Zoltek Pre-trial Br. at 7. Zoltek also attempts to characterize the letter as an admission by the Government because Northrop was a Government contractor. *Id.*

Neither of these arguments holds water. First, although this Court recognized at summary judgment that the Rodgers Letter is "reasonably attributable to the ability to vary the electrical surface resistivity of the products [Northrop] purchase[d]," it left the ultimate resolution of the issue to trial. *Zoltek Corp. v. United States*, 95 Fed.Cl. at 705. The only additional evidence before the Court in addition to this letter is Mr. Rodgers' testimony and the stipulations of the parties. While the Rodgers Letter can be said to "praise" the products produced by way of the '162 Patent, nothing in the evidence suggests that this was a particularly groundbreaking innovation. Indeed, after the first order used for testing the carbon fiber paper, Northrop never made any additional purchases. *See* J64.30-35. This testimony was supported

by Mr. Romy himself, who testified that Zoltek exited the business shortly after acquiring Stackpole. Tr. 376.

Zoltek's assertion that the Rodgers Letter is an admission by the Government borders on ludicrous. In its pre-trial brief, Zoltek argued that, as an employee of a Government contractor, Mr. Rodgers' statements constitute binding admissions by the Government. Zoltek Pre-trial Br. at 7-8. Zoltek relies primarily on Federal Rule of Evidence ("FRE") 801(d)(2)(C), arguing essentially that this is a statement against interest, and on *Pacific Gas & Elec. Co. v. United States*, 73 Fed.Cl. 333, 440 (2006), *rev'd in part on other grounds*, 536 F.3d 1282 (Fed. Cir. 2008).

FRE 801(d)(2) provides that a statement is not hearsay if it is offered against the opposing party and "was made by a person whom the party [here, the Government] authorized to make a statement on the subject." FRE 801(d)(2)(C). Applying the rule derived in *Pacific Gas*, such a statement would be admissible here under FRE 801(d)(2)(C) if the statements are (1) beneficial to, and offered at trial by, Zoltek, and (2) such statements were "authorized" by the Government. *See Pacific Gas*, 73 Fed.Cl. at 440. Unfortunately, while Mr. Rodgers' statement may be beneficial to Zoltek, Zoltek has failed to establish that the statements were "authorized" by the Government. At best, it appears that Mr. Rodgers worked for Northrop's Advanced Systems Division, whose "flagship was the design and validation and production of the B-2," J66.34, one of the aircraft at issue in this litigation. However, Zoltek has not pointed the Court to any evidence in the voluminous record before it that explicitly shows that the four rolls of paper ordered in December 1983 were used for the B-2, or any other Government project.<sup>7</sup>

#### **iv. The '162 Patent is Invalid Under 35 U.S.C. § 103**

In sum, Zoltek has failed to establish any serious evidence of secondary considerations under the *Graham* framework. The meager evidence presented, when weighed against the Government's strong prima facie showing of obviousness, does not render the '162 Patent non-obvious. For the reasons explained above, the Court concludes that, based on the evidence presented at trial, claims 1-22 and 33-38 of the '162 Patent are invalid as obvious under 35 U.S.C. § 103.

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<sup>7</sup> The Court recognizes that this deficiency may be due to Zoltek's inability to obtain the evidence after the Government invoked the state secrets privilege. Unfortunately, the relevant law requires the Court to proceed as if this evidence did not exist. *See Zoltek Corp. v. United States*, 86 Fed.Cl. 738, 747 (2009) (observing that "the effect of a successful invocation of the state secrets privilege 'is simply that the evidence is unavailable, as though a witness had died,' and that, with this in mind, 'the case will proceed accordingly.'" (quoting *Ellsberg v. Mitchell*, 709 F.2d 51, 64 (D.C. Cir. 1983))). That fact does not excuse Zoltek from the burden of producing actual evidence of secondary considerations.

## V. Claims 1-22 and 33-38 of the '162 Patent Are Invalid Under 35 U.S.C. § 112

The Government argues that all of the independent claims-at-issue (claims 1, 11, 15 and 33) are invalid under 35 U.S.C. § 112, ¶ 1.<sup>8</sup> Before turning to the merits, however, the Court will address a procedural issue raised by Zoltek prior to trial.

### a. Zoltek's Motion *in Limine* to Exclude the Government's § 112, ¶ 1 Defense

Prior to trial, by way of a motion *in limine*, Zoltek moved this Court to exclude the Government's § 112, ¶ 1 affirmative defense. Generally put, Zoltek's justification was that the Government failed to update its responses to Zoltek's interrogatories regarding the legal and factual basis for its § 112 defense "as required by Rules 26(b) and (e) and Rule 33" of the RCFC. *See* Docket No. 497 at 1. After reviewing the authority cited by Zoltek, the Court denied Zoltek's motion "without prejudice to Zoltek raising the issue again after trial." Docket No. 511 at 1.

Rather than raising the issue anew post-trial, Zoltek opted to substantively join the Government's § 112 theory. *See* Zoltek Post-Trial Brief at 34-38. Based on Zoltek's failure to raise its procedural argument, the Court concludes that Zoltek has abandoned the position. As such, the Court will turn to the merits of the Government's argument.

### b. The Government's Invalidity Contentions Under § 112, ¶ 1

The '162 patent is a reissue of the '395 patent. In general, the issue before the Court is whether the claims and specification in the reissue patent go beyond the written description of the invention in the original patent application.

Specifically, the parties' dispute resolves itself into two separate questions. The first question is whether the specification, as originally filed, contains support for the amended claim language calling for "previously oxidized and stabilized" starting material, as opposed to affirmatively requiring a step of oxidizing and stabilizing. The Government argues that this amendment is not supported by the as-filed specification. Zoltek counters that the scope of the claims is unchanged, essentially driving at the point that the amendment is a superficial change made to accommodate changes in the market that allow for purchase of pre-made starting material.

The second question is whether the amendment impermissibly removed the requirement that oxidation occurs on the "order of 220 Degrees Centigrade to effect molecular aromatic rearrangement." *See* J2.133-J2.136 (specification amendments); J2.175-J2.181 (accepted claim

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<sup>8</sup> The America Invents Act amended § 112 in generally cosmetic ways, but those amendments are not applicable to this case. *See* Pub.L. No. 112-29, sec. 4(c), 125 Stat. 284, 297 (explaining that these amendments will not take effect until September 16, 2012, and only apply to patent applications filed on or after September 16, 2012). Thus, the prior version of § 112 applies in this case.

amendments). The Government argues that the removal of this requirement violates Federal Circuit precedent, such that the claims must be found invalid. Zoltek's brief does not directly address this point.

In order to better understand the Government's written description argument, a brief review of the history of the '162 Patent is worthwhile. Three trial exhibits are relevant to the Government's § 112 challenge: J1, the '162 Patent; J2, the prosecution history for the '162 Patent; and J3, the prosecution history for the '395 Patent.

The application that matured into the '395 Patent was filed on October 12, 1984, and it issued on March 1, 1988. Less than two years later, on February 20, 1990, Zoltek filed an application seeking reissue of the '395 Patent: (1) "for the reason that the specification and claims thereof are defective and insufficient ... through inadvertence and oversight," (2) to "more clearly describe and claim the invention in conformance with the requirements of 35 U.S.C. § 112," (3) to establish "the patentably distinguishing features of the Boyd invention over the cited prior art," and (4) to add "a set of new claims ... rephrased ... to more precisely point out what is believed to be patentably novel." J2.31-33. During these reissue proceedings, Zoltek amended some of the claim language, as demonstrated in claim 1:

A method of manufacturing a plurality of different value controlled resistivity carbon fiber sheet products employing a carbonizable starting material; said method comprising **[oxidizing and stabilizing the carbonizable fiber starting material at an elevated temperature of the order of 220 degrees Centigrade to effect aromatic rearrangement of the fibers,]** selectively *partially* carbonizing [the] *previously* oxidized and stabilized fiber starting material for a predetermined period in an oxygen free atmosphere within a furnace at [a] selected temperature *values* within a temperature range from 370 degrees Centigrade to about 1300 degree Centigrade by soaking the stabilized fiber starting material at the selected temperature for the predetermined period of time to provide a [desired] *preselected known volume* electrical resistivity to the *partially* carbonized fibers *corresponding to that volume electrical resistivity value required to provide the preselected desired surface resistance value for the finished sheet products,* and thereafter processing the *partially* carbonized fibers into [desired electrical resistivity] *homogeneous* carbon fiber sheet products [having the form of non-woven paper or woven or knitted fabric sheet products] having *the* preselected desired surface electrical [resistivities] *resistances*.

'162 Patent at 8:42-66 (bold added, italics in original).<sup>9</sup>

The specification was also amended during reissue. Of particular relevance to the issues raised by the Government is the following amended statement, in context:

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<sup>9</sup> Recall that brackets indicate removal of language from the original claims, and italics indicate language added during reissue proceedings.

After heating and drawing the carbonizable material is oxidized at an elevated temperature of the order of 220 degrees Centigrade to effect aromatic molecular rearrangement of the starting material. *In the event the precursor starting material previously has been stabilized and oxidized by a supplier of such material, then this step may be eliminated.*

‘162 Patent 2:32-38. The italicized language was added during reissue proceedings.

With this background in mind, the Court turns to the issues raised by the Government at trial. 35 U.S.C. § 112, ¶ 1 states:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

This single paragraph is a patent defendant’s Swiss Army Knife: it places several distinct burdens upon a patent applicant, each of which must necessarily be met to obtain a valid patent. Fortunately, the Government only raises one of these burdens: written description.

The determination of whether a patent complies with the written description requirement is a question of fact. *Ariad Pharmaceuticals, Inc. v. Eli Lilly and Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc). “[T]he test for sufficiency is whether the disclosure of the application relied upon reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date.” *Id.* “The purpose of the written description requirement is to ensure that the scope of the right to exclude, as set forth in the claims, does not overreach the scope of the inventor’s contribution to the field of art as described in the patent specification.” *Id.* at 1353-54.

The first question is whether the specification, as originally filed, contains support for the amendment calling for “previously oxidized and stabilized” starting material, as opposed to requiring a step of oxidizing and stabilizing.

In general, Zoltek’s position in its post-trial brief is that the Government’s § 112 ¶ 1 argument has already been rejected by the Court in its decision on the Government’s earlier Motion for Partial Summary Judgment based on § 112 ¶ 2. *See Zoltek Corp. v. United States*, Civ. No. 96-166, Docket No. 90 (Fed. Cl. Sept. 23, 1999); *see also* Zoltek Post-Trial Br. at 35, 37-38. Zoltek’s position, however, immediately raises the question of how a decision based on one part of a statute automatically disposes of an argument based on another part of a statute. In other words, it is more logical to assume that decisions based on different parts of a statute are independent of one another rather than that one decision compels the same result in another. Thus, Zoltek needs to persuade the Court how its ¶ 2 decision determines its ¶ 1 decision.

Zoltek's argument on this point is imprecise. It notes that the issue in the ¶ 2 decision was indefiniteness due to a lack of a proper antecedent basis, which characterization is correct. Zoltek then quotes extensively from the Court's ¶ 2 opinion, but with no argument on how the quoted text relates to the Government's ¶ 1 argument in this phase of the case. Zoltek ends its discussion of the Court's ¶ 2 with the following conclusory remark:

This Court thoroughly dealt with this issue in its September 13, 1999 Opinion... Asserting the same factually insufficient arguments to support a §112 lack of written description defense is simply a waste of this Court's time.

Zoltek Post-Trial Br. at 38.

The touchstone for determining whether a claim is indefinite was stated in the Court's ¶ 2 decision: "Whether a claim is invalid under § 112 ¶ 2 requires a determination as to whether those skilled in the art would understand what is claimed when the claim is read in light of the specification." *See Zoltek Corp. v. United States*, Civ. No. 96-166, Docket No. 90, at 3-4 (quoting *Messerschmidt v. United States*, 29 Fed.Cl. 1, 41 (1993)). In its decision, the Court was asked to compare the claims and the specification to see whether there was an antecedent basis for the claims in the reissue patent that eliminated the step of oxidizing and stabilizing. The Court found that there was an antecedent basis such that one skilled in the art would be able to understand the scope of the claims in the reissue patent. Whether the claims and specification went beyond the written description is another matter. If this were not so, why would § 112 have a ¶ 1 and a ¶ 2? The most that the Court can discern in Zoltek's post-trial brief argument on this issue is that the facts are identical in the Government's arguments regarding ¶¶ 1 and 2. *See Zoltek Post-Trial Br. at 35, 37-38.*

Considering Zoltek's vague argument and examining its earlier decision and the different question presented to it now, the Court does not agree that its earlier opinion is controlling of the issue now at bar. Again, that decision was reached in the context of 35 U.S.C. § 112, ¶ 2, under which provision the Government argued that the claims were indefinite for lack of an antecedent basis because the "oxidizing and stabilizing" step had been deleted. The Court's decision relied upon a sentence added during reissue proceedings, namely, the statement that "[i]n the event the precursor starting material previously has been stabilized and oxidized by a supplier of such material, then this step [oxidizing and stabilizing the starting material] may be eliminated." *See Zoltek Corp. v. United States*, Civ. No. 96-166, Docket No. 90 at 5 (quoting '162 Patent at 2:36-38).

The Court reached its conclusion in part on the basis of the amended specification. It is precisely that amendment that the Government now challenges, and the Court agrees with the Government's position. Nothing in the *original* specification disclosed the possibility that the starting material could be oxidized and stabilized outside the confines of the described method (as the amended claims suggest), and as such, the specification amendment is unavailing.

The fact that oxidation and stabilization was allegedly part of the prior art, which fact the Court also relied upon in the 1999 Opinion, is irrelevant to the question of whether the written description requirement is satisfied. As the Federal Circuit recently stated,

To satisfy the written description requirement, a patent applicant must convey with reasonable clarity to those skilled in the art that, as of the filing date sought, he or she was in possession of the invention. The invention is, for purposes of the “written description” inquiry, *whatever is now claimed*. Such description need not recite the claimed invention *in haec verba* but must do more than merely disclose that which would render the claimed invention obvious.

*ICU Medical, Inc. v. Alaris Medical Systems, Inc.*, 558 F.3d 1368, 1377 (Fed. Cir. 2009) (citations omitted; emphasis in original); *see also PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1306-07 (Fed. Cir. 2008) (explaining that § 112, ¶ 1 “requires that the written description actually or inherently disclose the claim element”). As the Government asserts, the original specification discloses nothing that suggests a method calling for a *previously* oxidized fiber. It repeatedly calls for the party performing the steps of the invention to oxidize and stabilize the starting material *as part of the description of the invention*. As such, purchasing the pre-made starting materials was not disclosed in the original specification and independent claims 1, 11, 15 and 33 and those claims which depend upon them are invalid for lack of written description.

The second question focuses in on the temperature requirement in contrast to the broader point of the stabilization and oxidation step of the first question. With respect to the question of whether the temperature requirement has been removed from the claims, the Court also finds that the claims are invalid. Once again, the disclosure contained in the specification consistently refers to the necessity of performing the oxidizing and stabilizing step at a temperature of the order of 220 degrees Centigrade in order to effect aromatic rearrangement of the molecules of the starting material. *See* ‘162 Patent at 2:33-35; 3:33-36; 4:46-49. In each instance where the oxidation and stabilization step is discussed (in both the original specification and the amended specification), the specification emphasizes the need to perform the step at an elevated temperature to achieve aromatic rearrangement. This temperature requirement, repeatedly emphasized in the original specification, is conspicuously absent from all of the reissued claims.

In effect, then, the amended claims call for oxidation and stabilization at any temperature, while the original specification makes quite clear that this step *must* occur at a temperature on the order of 220 degrees Centigrade. This constitutes new matter, which may not be added during prosecution of the patent application. *See Baldwin Graphic Systems, Inc. v. Siebert, Inc.*, 512 F.3d 1338, 1344 (Fed. Cir. 2008). The *Baldwin* case is instructive because it addressed a very similar modification: in that case, the applicant amended a claim limitation from “heat-sealed sleeve” to “sealed sleeve.” *Id.* The Federal Circuit noted that allowing the claim term to be read as only requiring a “sealed sleeve” would broaden the patent beyond the original disclosure. *Id.* As here, the applicant in *Baldwin* sought to remove a temperature-based requirement from the claims despite the fact that the originally-filed specification emphasized temperature. Thus, the Court finds that *Baldwin* is essentially on all fours with the issue now before the Court.



In sum, the written description and the claims in the original patent do not support the elimination of the oxidization and stabilization step and the elimination of oxidizing and stabilizing according to the temperature requirement.<sup>10</sup> Doing so impermissibly broadens the patented process by reducing the number of steps required for infringement. A potential infringer need not practice the oxidation and stabilization step at the required temperature in order to infringe the '162 Patent, whereas that step was necessary in the '395 Patent. For that matter, a potential infringer need not practice the oxidation and stabilization step at all to infringe the '162 Patent. It is enough to purchase starting material that was previously oxidized and stabilized, regardless of how that oxidation and stabilization was achieved.

For these reasons, the Court concludes that claims 1, 11, 15 and 33 (and all claims which depend therefrom) are invalid under 35 U.S.C. § 112, ¶ 1. There is no evidence in the trial record to support a conclusion that the originally filed disclosure of October 12, 1984, contained support for either (1) a method calling for previously oxidized fiber or (2) a method calling for oxidation at a temperature other than “at an elevated temperature of the order 220 Degrees Centigrade to effect molecular aromatic rearrangement of the starting material.”

## **VI. Conclusion**

After extraordinarily long proceedings and after hearing the testimony at trial, the Court is satisfied by the Government's arguments that the '162 Patent's claims at issue (claims 1-22 and 33-38) in this litigation are invalid under 35 U.S.C. §§ 103 and 112. Judgment in favor of the Government is, therefore, appropriate. The Clerk is directed to enter judgment accordingly.

/s Edward J. Damich

Edward J. Damich  
Senior Judge

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<sup>10</sup> In its previous decision, the Court stated that “it can hardly be said that the oxidizing and stabilizing step was removed *from the Reissue '162.*” *Zoltek Corp. v. United States*, Civ. No. 96-166, Docket No. 90 at 5. In the context of a ¶ 2 argument, this means that the step is referred to in the claims and the specification and is mentioned in the original patent as well. In the context of a ¶ 1 argument, although the step is *found* in the reissue patent, its elimination from the claimed process goes beyond the written description of the invention in the original '395 patent.