UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte HIROFUMI FUKUOKA, SATORU MIYAWAKI,
KAZUMA MOMII, MIKIO ARAMATA,
and SUSUMU UENO

Appeal 2007-1118
Application 10/237,089
Technology Center 1700

Decided: July 12, 2007

Before PETER F. KRATZ, CATHERINE Q. TIMM, and
JEFFREY T. SMITH, *Administrative Patent Judges*.

Majority opinion for the Board filed by Administrative Judge Timm.
Concurring opinion filed by Administrative Judge Smith.

TIMM, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 1-14 and 16-20. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

I. BACKGROUND

The invention relates to a conductive silicon oxide powder, a negative electrode material comprising the powder, and a method of preparing the powder. The negative electrode is used in a lithium ion secondary battery cell (Specification 1:7-11). Claims 1, 8, and 9 are illustrative of the subject matter on appeal:

1. A conductive silicon oxide powder in which particles of silicon oxide having the general formula: SiO_x wherein $1 \leq \times < 1.6$ are covered on their surfaces with a conductive coating by chemical vapor deposition treatment.

8. A negative electrode material for a non-aqueous electrolyte secondary cell, comprising a mixture of the conductive silicon oxide powder of claim 1 and 1 to 60% by weight of a conductive agent, the mixture having a total carbon content of 25 to 90% by weight.

9. A method for preparing the conductive silicon oxide powder of claim 1, comprising the step of heat treating particles of silicon oxide having the general formula: SiO_x wherein $1 \leq \times < 1.6$ in an atmosphere containing at least an organic gas or vapor at a temperature of 500 to 1,200°C.

The Examiner relies on the following prior art references to show unpatentability:

Sakashita (as translated)	JP 2001-185125	Jul. 6, 2001
Umeno	US 6,383,686 B1	May 7, 2002

The Examiner rejects claims 1-14 and 16-20 under 35 U.S.C. § 103(a) as unpatentable over Sakashita in view of Umeno.

II. DISCUSSION

A. Issue

To determine the issues on appeal, we have reviewed the contentions of the Appellants and the Examiner as presented in the Brief filed June 22, 2006, the Answer filed September 8, 2005, the Reply Brief filed November 4, 2005, the Supplemental Answer filed August 4, 2006, and the Supplemental Reply Brief filed October 4, 2006.

Appellants' main contention as presented in their Briefs is that there is no suggestion in the prior art for combining the SiO_x particles of Sakashita with the chemical vapor deposited carbon coating of Umeno and that their showing of unexpected results provides sufficient evidence of nonobviousness. The Examiner finds that the suggestion to combine arises from the teachings of Umeno. The main issue arising from the contentions of Appellants and the Examiner is: Have Appellants overcome the rejection by showing insufficient evidence of prima facie obviousness or by rebutting the prima facie case with sufficient evidence of unexpected results? *See In re Kahn*, 441 F.3d 977, 985-86, 78 USPQ2d 1329, 1335 (Fed. Cir. 2006) ("On appeal to the Board, an applicant can overcome a rejection by showing insufficient evidence of prima facie obviousness or by rebutting the prima facie case with evidence of secondary indicia of nonobviousness." (emphasis omitted)).

B. Facts

Sakashita, Umeno, and Appellants' invention are all directed to an electrode active material for use in non-aqueous secondary batteries also known as secondary lithium ion batteries (Sakashita ¶ 1; Umeno ¶ 1; Specification 1:7-11).

Sakashita describes an electrode active material including SiO_x (x=1.05-1.60) powder mixed with a conductive material of carbon black powder (Abstract; ¶ 5). The carbon black powder serves as a conduction agent (Sakashita ¶ 11). The SiO_x and carbon black are mixed together in the form of a slurry (Sakashita ¶ 14).

The SiO_x powder of Sakashita is "capable of storing and releasing lithium ions" or, in other words, "capable of forming a lithium alloy" (Sakashita, Abstract; ¶ 5; *see also* Sakashita ¶ 3 and Umeno, col. 3, ll. 1-3; finding of the Examiner, Answer 7).

We determine that Sakashita's SiO_x (x=1.05-1.60) powder contains a mixture of silicon (Si) and silicon dioxide (SiO_2). This determination is based on the method of making the SiO_x. which is substantially similar to Appellants' process of mixing Si and SiO_2 at temperatures on the order of 1400 °C (Compare Sakashita ¶ 8 to Specification 4:1-31 and 11:13-21) and Sakashita's disclosure that analysis of the SiO_x powder by x-ray photoelectron spectroscopy 750, for example, "ESCA," gives "a peak which is different in Si and SiO_2" (Sakashita ¶ 9). That both Si and SiO_2 are present is further evinced by the teaching of Sakashita that the SiO_x powder is "capable of storing and releasing lithium ions" (Sakashita, Abstract; ¶ 5).

It is the Si that is active, SiO_2 being inactive electrochemically (Specification 4:11-16).

Umeno also describes an anode active material for a lithium secondary battery (Umeno, col. 1, ll. 11-12). Umeno's anode is said to have a large capacity, high safety, and excellent charging and discharging cycle property (Umeno, col. 1, ll. 12-14). Umeno recognized a problem with the volume of the anode expanding several-fold as lithium alloyed with the active material (e.g., silicon) within the anode, the expansion resulting in powderizing which destroys the anode (Umeno, col. 2, ll. 12-39). Umeno solves the problem of electrode powderization and destruction by covering the lithium alloy-forming core particles with an expansion inhibiting layer of carbon (Umeno, col. 2, ll. 48-68). The coating further suppresses oxidation during charging and discharging of the battery (Umeno, col. 6, ll. 22-24) as well as improves the conductivity of the particulate core and allows the lithium to be supplied uniformly to the core from the whole outer surface of the carbon layer thus improving charging and discharging speeds (Umeno, col. 6, ll. 26-33). As the material for the core particles, Umeno suggests selecting "metal and semimetal … capable of forming a lithium alloy" and discloses a preference for titanium, iron, boron, and silicon with a particular preference for silicon (Umeno, col. 4, ll. 38-44). Umeno does not expressly state that SiO_x can be used as a particulate core material, although Umeno notes that silicon oxide is present in silicon as an allowable impurity, it being inactive electrochemically (Umeno, col. 4, ll. 45-49).

The Fukuoka I Declaration provides data for lithium ion secondary battery cells constructed and tested as in Appellants' Example 2 of the

Specification except that silicon powder was used instead of SiO_x powder. Comparison data for this example and the examples presented in the Specification is provided in Table 1. The first charge and discharge capacities of the comparison example are higher than those of Appellants' Example 2, but the capacity retentivity after 30 cycles is lower (45% versus 98%).

The Fukuoka II Declaration provides data for a lithium ion secondary battery cell constructed and tested as in Appellants' Example 2 except that silicon powder made according to Umeno's Example 1 was used. Again, the first charge and discharge capacities of the comparison are higher than those of Appellants' Example 2, but the capacity retentivity after 30 cycles is lower (44%).

C. Analysis

We focus first on the question of whether Appellants have overcome the rejection by showing that the evidence is insufficient to support the Examiner's case of obviousness. Appellants' contention in this regard is that there is no suggestion of using the SiO_x particles of Sakashita with the chemical vapor deposited carbon coating of Umeno because Umeno expressly defines the range of useful core materials as limited to metals and semimetals, of which SiO_x (x=1.05-1.60) is not.

Appellants' argument is insufficient to rebut the Examiner prima facie case of obviousness for the following reasons.

First, Appellants do not convincingly address the Examiner's finding that Umeno's suggested materials have the same function as Sakashita's

SiO_x (x=1.05-1.60), i.e., the material is ultimately selected to alloy with, or absorb, lithium ions (Answer 7).

Second, there are several bases for one of ordinary skill in the art to have been led to combine the coating of Umeno with the particles of Sakashita that arise from benefits taught by Umeno any one of which would have been sufficient to support the prima facie case of obviousness. Umeno articulates several benefits to using a carbon coating that one of ordinary skill in the art would have expected to obtain when the coating were placed on Sakashita's SiO_x (x=1.05-160) particles including suppression of expansion during lithium ion alloying, prevention of further oxidation during charging and discharging, and improvement in conductivity. Umeno's disclosure of conductivity improvement provides a strong reason to combine because Sakashita expressly teaches that conductivity improvement is desirable as noted in the above findings of fact. Thus, an ordinarily skilled artisan would have expected that Umeno's carbon coating would be suitable as an additive source of conductive carbon or as a substitution of a carbon source for use in Sakashita's conductive electrode. Another reason for making the combination arises from the expected added benefit of suppressing any expansion that might occur when Sakashita's SiO_x (x=1.05-160) particles, or the Si particles therein, absorb lithium ions. Umeno teaches that the expansion inhibiting carbon coating will prevent the powderization and destruction of the anode and improve cycle properties (Factual findings above).

With regard to the benefit of suppressing expansion, it is reasonable to conclude that because the SiO_x of Sakashita stores lithium ions, one of

ordinary skill in the art would have recognized that the anodes of Sakashita would be subject to the same expansion, powderization, and destruction Umeno solves by carbon coating (Answer 7). This is especially true because the SiO_x of Sakashita is a mixture of Si and SiO_2. One of ordinary skill in the art would have expected the carbon coating to prevent expansion of the Si particles of the SiO_x material. This reason to combine the teachings of the references arises from the implicit teachings of the prior art. A teaching, suggestion, or motivation to combine the relevant prior art teachings does not have to be found explicitly in the prior art, as the teaching, suggestion, or motivation may be implicit from the prior art as a whole. *In re Kahn*, 441 F.3d 977, 987-88, 78 USPQ2d 1329, 1336 cited with approval in *KSR Int'l. Co. v. Teleflex Inc.,* 127 S. Ct. 1727, 1740-41, 82 USPQ2d 1385, 1395-96 (2007). In evaluating the prior art references for a suggestion, it is proper to take into account not only the specific teachings of the references, but also any inferences which one skilled in the art would reasonably be expected to draw therefrom. *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968).

Umeno indicates that there is an expansion problem when the electrode includes lithium alloying active material such as Si. Umeno solves the problem by applying a carbon coating. Sakashita describes an electrode with lithium alloying active material containing Si. It would have been obvious to try applying the coating of Umeno on the active material of Sakashita, the expectation being that the coating would enhance conductivity and suppress expansion. As stated in *KSR Int'l*:

> 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. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.

KSR Int'l. Co. v. Teleflex Inc., 127 S. Ct. 1727 at 1742, 82 USPQ2d at 1397.

In determining that there was a reason to combine the teachings of the cited references, the Examiner properly took into account the interrelated teachings of the prior art references, the effects of the demands on those in the lithium ion secondary battery art to improve cycle retention and charging speed, and the background knowledge of the ordinary artisan as evidenced by the references. *See KSR Int'l. v. Teleflex Inc*., 127 S.Ct. 1727, 1740-41, 82 USPQ2d 1385, 1396 (2007) ("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 at issue.").

We now turn to the second question of whether Appellants have overcome the rejection by rebutting the prima facie case with sufficient evidence of unexpected results.

Once a prima facie case of obviousness is established, the burden of coming forward with evidence and argument in rebuttal is shifted to appellants. *See In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984). Rebuttal may take the form of "a comparison of test data showing that the claimed compositions possess unexpectedly improved

properties ... that the prior art does not have, that the prior art is so deficient that there is no motivation to make what might otherwise appear to be obvious changes, or any other argument ... that is pertinent." *In re Dillon*, 919 F.2d 688, 692-93, 16 USPQ2d 1897, 1901 (Fed.Cir.1990) (en banc) (citations omitted).

We cannot say that Appellants have shown that there was no motivation to make what might otherwise appear to be obvious changes. Appellants have not shown that there is a difference in properties that would have been unexpected to the ordinary artisan. "In order for a showing of 'unexpected results' to be probative evidence of non-obviousness, it falls upon the applicant to at least establish … that the difference actually obtained would not have been expected by one skilled in the art at the time of invention." *In re Freeman*, 474 F.2d 1318, 1324, 177 USPQ 139, 143 (CCPA 1973) (citations omitted). Appellants state in their Briefs that the results are unexpected, but the comments made in the Briefs are mere attorney argument and cannot take the place of evidence. *In re Greenfield*, 571 F.2d 1185, 1189, 197 USPQ 227, 230 (CCPA 1978) (arguments of counsel cannot take the place of evidence). One of ordinary skill in the art would have expected there would be a difference in results based on the difference in materials in the core. One ordinary skill in the art also would have also expected an improvement in the cycle retention of Sakashita's SiO_x particles upon coating those particles with carbon because Umeno discloses that the coating improves cycle retention by inhibiting expansion.

Furthermore, Appellants have presented test data for only carbon coatings whereas the claims are not so limited. The data presented does not

present examples that represent all of the particle sizes encompassed by the claimed invention. "Establishing that one (or a small number of) species gives unexpected results is inadequate proof, for 'it is the view of this court that objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support.'" *In re Greenfield*, 571 F.2d at 1189, 197 USPQ at 230 (quoting *In re Tiffin*, 448 F.2d 791, 792, 171 USPQ 294, 294 (CCPA 1971)). Appellants have not explained why the few examples presented are representative of the entire scope of the claimed invention.

Based on the totality of record, including due consideration of the Appellants' arguments and evidence, we determine that the preponderance of evidence weighs most heavily in favor of obviousness within the meaning of 35 U.S.C. § 103. Accordingly, we sustain the rejection of claim 1 and those claims standing or falling therewith.

Appellants argue claim 4 separately. According to Appellants, claim 4 is limited to a carbon coating, and the Fukuoka Declarations even more strongly support the patentability of claim 4 because these Declarations report data on carbon coatings (Br. 16). The evidence is insufficient because, as explained above, Appellants have not shown that the result would have been unexpected to one of ordinary skill in the art.

With respect to claims 2, 3, 5-8, 13, 14, and 16-20 Appellants argue that none of the features of these claims are disclosed by the cited references (Br. 15-16). There is no sufficiently specific argument to address nor is the Examiner's specific reasoning disputed (Answer 4-5) and, therefore, we

sustain the rejection of these claims for the reasons discussed above in reference to claim 1.

With respect to claims 9 and 10, Appellants argue that the method patentably defines over Umeno because Umeno fails to disclose or suggest the use of SiO_x and the method patentably defines over Sakashita because Sakashita fails to disclose heating to the claimed 500-1200°C temperature (Br. 17). We are not convinced. As pointed out by the Examiner, Umeno describes heating to 700-1200°C when chemical vapor depositing carbon onto the particles. When one was coating the particles of Sakashita with carbon by CVD, one would use the temperatures suggested by Umeno or would adjust the temperature through routine experimentation to obtain the desired carbon coating.

With respect to claims 11 and 12, Appellants argue that Umeno and Sakashita fail to disclose the use of a fluidized bed reactor, or a reactor having a specified linear velocity as required by these claims (Br. 17). We note that Umeno describes conducting the chemical vapor deposition "with the particulate core kept in a fluidized state." (Umeno, col. 6, ll. 10-12). Determination of the velocity of the gas flow would have been within the level of one of ordinary skill in the art. *Cf. Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1368, 82 USPQ2d 1321, 1335-36 (Fed. Cir. 2007) (discovery of an optimum value of a variable in a known process is usually obvious.) and *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955) ("[I]t is not inventive to discover the optimum or workable ranges by routine experimentation.").

III. DECISION

The decision of Examiner to reject claims 1-14 and 16-20 under 35 U.S.C. § 103(a) as unpatentable over Sakashita in view of Umeno is AFFIRMED.

SMITH, Administrative Patent Judge, concurring-in-result.

I concur with the panel's decision to affirm the Examiner's § 103 rejection of claims 1-14 and 16-20.

I agree that a person of ordinary skill in the art to have been led to combine the coating of Umeno with the particles of Sakashita. A person of ordinary skill in the art would have reasonably expected that the problems addressed by Umeno would also have been experienced by Sakashita due to the presence of Si. As such, a person of ordinary skill in the art would have reasonably expected that coating Sakashita's SiO_x particles would have suppressed expansion during lithium ion alloying, and prevent further oxidation during charging and discharging, as well as provide improved conductivity has taught by Umeno.

I also agree that Appellants' evidence of unexpected results is insufficient to overcome the Examiner's prima facie case of obviousness. Appellants have failed to point to evidence indicating that the results were considered to be unexpected to one of ordinary skill in the art. "It is well settled that unexpected results must be established by factual evidence. Mere argument or conclusory statements in the specification does not suffice." *In re Soni*, 54 F.3d 746, 750, 34 USPQ2d 1684, 1687 (Fed.Cir.1995) (*quoting In re De Blauwe*, 736 F.2d 699, 705, 222 USPQ

191, 196 (Fed.Cir.1984)). The question here, we emphasize, is a question of evidence and the burden is on the Appellants to show unexpected results. *In re Johnson*, 747 F.2d 1456, 1460, 223 USPQ 1260, 1263 (Fed. Cir. 1984).

Further, the data relied upon by Appellants is not commensurate in scope with the claimed invention *See In re Greenfield*, 571 F.2d 1185, 1189, 197 USPQ 227, 230 (CCPA 1978) ("Establishing that one (or a *small* number of) species gives unexpected results is inadequate proof, for 'it is the view of this court that objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support'." (*quoting In re Tiffin*, 448 F.2d 791, 792, 171 USPQ 294, 294 (CCPA 1971)). Appellants test only a few compositions, as exhibited in the Declarations. Appellants have presented test data for only carbon coatings whereas the claims are inclusive of all conductive coatings. The data presented does not present examples that represent all of the particle sizes encompassed by the claimed invention. Appellants also have not explained why the few examples presented are representative of the entire scope of the claimed invention.

IV. TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal maybe extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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