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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte ZHENGCHENG ZHANG, JIAN DONG, and KHALIL AMINE[1]

Appeal 2017-011573
Application 13/551,115
Technology Center 1700

Before JANET A. GONGOLA, *Vice Chief Administrative Patent Judge,* and ROMULO H. DELMENDO, and JAMES T. MOORE, *Administrative Patent Judges*.

GONGOLA, *Vice Chief Administrative Patent Judge*.

DECISION ON APPEAL

Appellants file this appeal under 35 U.S.C. § 134(a) from a rejection of claims 11 and 14–19. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM, but designate our affirmance as a new ground of rejection under 37 C.F.R. § 41.50(b).

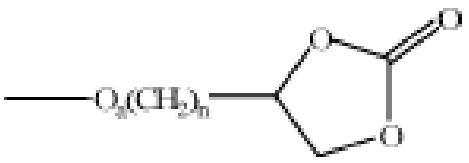
BACKGROUND

[1] Appellants identify the real party in interest as UChicago Argonne LLC. Appeal Brief filed April 5, 2017 ("App. Br.") 2.

Appellants' claims are directed to an electrolyte for a lithium ion battery; the electrolyte includes an organosilicon solvent, propylene carbonate, and a salt. Specification filed July 17, 2012 ("Spec.") ¶¶ 2–3. The Specification discloses that propylene carbonate "is not a suitable electrolyte component for lithium-ion batteries having a graphite anode," due to exfoliation of the graphite and decomposition of propylene carbonate. *Id.* at ¶ 23. The Specification discloses, however, that using "an organosilicon compound as a cosolvent for propylene carbonate . . . effectively suppresses [propylene carbonate] decomposition and successfully eliminates the exfoliation of the graphite anode." *Id.* at ¶ 24.

Claim 11 is representative of the subject matter on appeal and is reproduced below:

> 11. A lithium ion battery comprising
> an anode comprising synthetic graphite, natural graphite, amorphous carbon, hard carbon, soft carbon, acetylene black, mesocarbon microbeads (MCMB), carbon black, Ketjen black, mesoporous carbon, porous carbon matrix, carbon nanotube, carbon nanofiber, or graphene;
> a cathode; and
> an electrolyte, the electrolyte comprising:
> propylene carbonate;
> a salt; and
> an organosilicon solvent of formula $SiR^1R^2R^3OR^4$;
> wherein:
> R^1 and R^2 are individually alkyl, aryl, alkoxy, or siloxy;
> R^3 is



, or

; and

R^4 is $-(CH_2CH_2O)_nCH_3$ or $-(CH_2CH_2CH_2O)_nCH_3$;
a is 0 or l;
b is 0, 1, 2, or 3;
n is from 1 to 20; and
a ratio of organosilicon solvent to propylene carbonate in the electrolyte is from about 1:9 to about 9:1.

App. Br. 13 (Claims App.).

REJECTION ON APPEAL

The Examiner rejected claims 11 and 14–19 under 35 U.S.C. § 103(a) as unpatentable over Rossi[2] and Sakata.[3] Final Office Action entered October 12, 2016 ("Final Act.") 2.

Appellants do not argue any claim separately from claim 11. *See* App. Br. 5–11. Accordingly, we select claim 11 as representative of

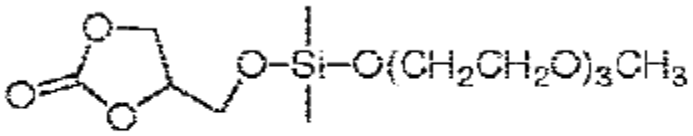
[2] Rossi et al., *Silicon-Containing Carbonates-Synthesis, Characterization, and Additive Effects for Silicon-Based Polymer Electrolytes*, 2 Silicon 201–208 (2010).
[3] Sakata et al., U.S. Pat. Pub. No. 2011/0052980 A1, published March 3, 2011.

dependent claims 14–19 and decide this appeal based on the rejection of claim 11. 37 C.F.R. § 41.37(c)(1)(iv).

DISCUSSION

I. Teachings of the Prior Art References

The Examiner finds that Rossi teaches an electrolyte comprising an organosilicon solvent having the formula:



4a

Final Act. 2, citing Rossi 205. The Examiner finds that Rossi's organosilicon solvent 4a is encompassed by the formula recited in claims 11 and 16. *Id.* The Examiner finds that Rossi teaches using the solvent with 0.8M of a lithium salt. *Id.*, citing Rossi 206. The Examiner finds that Rossi also teaches propylene carbonate is used in commercially available lithium batteries due to both its low viscosity, which enhances ionic mobility, and its high dielectric constant, which achieves high free ion concentration. *Id.* at 3–4, citing Rossi 201.

The Examiner acknowledges that Rossi does not expressly teach propylene carbonate combined with the organosilicon solvent or a lithium battery with the claimed anode and cathode. *See id.* at 2–3. The Examiner, however, finds that Sakata teaches a lithium battery having a positive electrode (i.e., cathode) and an anode made of (i) graphite, (ii) mesocarbon microbeads, or (iii) activated carbon. *Id.* at 3, citing Sakata ¶ 87, claim 1.

The Examiner finds that Sakata teaches propylene carbonate as an electrolyte. *Id.*, citing Sakata ¶ 35.

The Examiner finds that because propylene carbonate was widely used in lithium ion batteries, it would have been obvious to use the organosilicon solvent of Rossi as an electrolyte with the propylene carbonate of Sakata to obtain the advantages of the combined solvents. *Id.* at 4. The Examiner finds the combination would have yielded predictable results to one of ordinary skill in the art at the time of the invention. *Id.* at 3.

With respect to the ratio of organosilicon solvent to propylene carbonate, the Examiner finds that "the solvent ratio has an effect on viscosity and ion conductivity." *Id.* at 4. Accordingly, the Examiner finds that the claimed range is a result-effective variable that would have been obvious to optimize. *Id.*

Appellants contend the prior art does not teach or suggest all limitations of representative claim 11. *See* App. Br. 10. First, Appellants contend that "*Rossi does not use the cyclic carbonate siloxane material <u>in combination</u> with* [propylene carbonate] . . . . The silicon-containing cyclic carbonates of Rossi are used <u>instead of</u> . . . [ethylene or propylene carbonate]." *Id*. (emphasis added). Second, Appellants contend that Rossi fails to teach "the claimed ratio" and "the use of silicon-containing cyclic carbonates with carbon-based or graphite electrodes." *Id.*

We are not persuaded by Appellants' arguments as to Rossi. "Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references. . . . [The reference] must be read, not in isolation, but for what it

fairly teaches in combination with the prior art as a whole." *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). We observe that Rossi teaches that the "cyclic carbonate-based silane and siloxane compounds described here could potentially be used commercially as additives in lithium batteries." Rossi 208. Thus, in direct contrast to Appellants' allegation, Rossi suggests that the disclosed organosilicon compounds are additives for existing electrolytes in lithium batteries, e.g., propylene carbonate, and not replacements thereof.

As to Appellants' second argument, Rossi teaches that "upon addition of more than 20% w/w of the additives, the ionic conductivity begins to decrease . . . due to, in part, an increase in a viscosity of the mixture." *Id.* Accordingly, again in direct contrast to Appellants' allegation, Rossi suggests using the organosilicon solvent as an additive in an amount up to 20%, i.e., a ratio of 2:8, with a solvent having less viscosity, e.g., propylene carbonate.

Appellants further contend that Sakata describes a nonaqueous electrolyte that includes a fluorinated nitrile compound. App. Br. 10, citing Sakata ¶¶ 23, 24, and 41–43. Appellants contend that Sakata "fails to provide any indication of the use of the presently claimed electrolytes or the silicon-containing cyclic carbonates of Rossi." *Id.* In particular, Appellants contend that Sakata does not teach or suggest using propylene carbonate in "combination with oligoether electrolytes described in Rossi, or in combination with the silicon containing cyclic carbonates as presently claimed." *Id.*

We are not persuaded by Appellants' arguments with respect to Sakata. Sakata teaches propylene carbonate may be used as a part of a "mixed solvent" nonaqueous electrolyte solution. Sakata ¶ 35. Moreover, Sakata teaches that "additives other than the fluorinated nitrile compound(s) further can be added to the nonaqueous electrolytic solution." Sakata ¶ 51. Specifically, Sakata teaches that further additives include "a silicon-containing organic solvent" "preferably 30 mass% or less" so that the electric characteristics do not deteriorate. *See id.* at ¶¶ 55–56. Hence, in contrast to Appellants' allegation, we observe that Sakata suggests a mixed solvent electrolyte including propylene carbonate with additives, such as fluorinated nitriles and silicon-containing organic solvents.

In summary, the combined prior art teaches a lithium ion battery comprising a carbon-based anode, a cathode, an electrolyte comprising propylene carbonate, a salt, and 10–30% of an organosilicon solvent additive. Therefore, we are not persuaded that the Examiner erred in finding the combined prior art teaches all of the limitations of representative claim 11.

II. Reason to Combine the Prior Art References

Appellants contend the Examiner "appears to take a leap of logic in asserting that because 'all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions and the combination would have yielded predictable results.'" App. Br. 10–11. Appellants contend that the combination results in a modification of the

respective functions of the prior art components "in that in the presence of the silicon-containing cyclic carbonates and [propylene carbonate] with a carbon/graphite based electrode, the [propylene carbonate] does not degrade, the electrode does not exfoliate, and lithium battery cell operation is not negatively impacted." *Id.* at 11.

We find that the prior art provides express reasoning to combine the references. "In determining whether the subject matter of a patent claim is obvious, neither the particular motivation nor the avowed purpose of the patentee controls. What matters is the objective reach of the claim. If the claim extends to what is obvious, it is invalid under § 103." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 419 (2007).

Appellants' claims are directed to a lithium ion battery comprising a number of components. The Examiner has identified these components in the prior art. The prior art further teaches that the components were previously known for use in lithium ion batteries. More specifically, Sakata teaches lithium ion batteries including carbon-based anodes, cathodes, and a mixed nonaqueous electrolyte. *See* Sakata ¶¶ 33–35, 87. Sakata teaches the mixed nonaqueous electrolyte may include propylene carbonate, a salt, and preferably up to 30% additives, such as a silicon-containing organic solvent. Sakata ¶¶ 35, 37, 55–56. Rossi teaches that "that the cyclic carbonate-based silane and siloxane compounds described here could potentially be used commercially as additives in lithium batteries," in amounts up to 20% w/w. Rossi 208. Therefore, Rossi expressly suggests using the claimed organosilicon solvent as an additive for a mixed solvent system in a lithium battery, e.g., as taught by Sakata. Because the prior art provides an express

reason to combine Rossi's organosilicon additive with Sakata's mixed solvent electrolyte, we conclude that the claims would have been prima facie obvious over the prior art.

Nevertheless, because the Examiner did not articulate a reason to combine the references based on the additional factual findings discussed above, we designate our affirmance as a New Ground of Rejection to provide Appellants a fair opportunity to address these teachings and our now express findings.

III. Consideration of Unexpected Results

Appellants contend "the combination of the propylene carbonate [] and the siloxane in the stated ratio of the claim, when in the presence of the stated anode, [] provides a synergistic effect." App. Br. 6. Appellants submit the Declaration of co-inventor Zhengcheng Zhang[4] to support the alleged synergistic effect. *Id.* Appellants assert that "when cells are prepared with [propylene carbonate] alone, a cyclic carbonate siloxane, or a polyethylene oxide siloxane, the cells degrade rapidly due to exfoliation of the graphite and no, or minimal, [solid electrolyte interface] formation." App. Br. 7, citing Zhang Decl. ¶¶ 8–10. Appellants assert, by contrast, "when cells are prepared using the siloxane having both polyethyleneoxide and cyclic carbonate moieties [i.e., the compound of claim 16], the performance is greatly enhanced." App. Br. 7–8, citing Zhang Decl. ¶ 6.

The Examiner responds that "[e]vidence to show criticality or unexpected results must show a comparison of the claimed invention to the

[4] Declaration of Zhengcheng Zhang dated August 8, 2016 ("Zhang Decl.").

closest prior art." Examiner's Ans. dated July 7, 2017 ("Ans.") 4. The Examiner finds "Appellants are asserting that the claimed siloxane (cyclic+ EO groups) **itself** has a synergism over any of the compounds individually . . . . However, this [is] not commensurate with the claimed invention, nor it is the proper comparison to make." *Id.* at 4–5. The Examiner states that "the claimed invention is a siloxane with cyclic + EO groups . . . This comparison has yet to be made." *Id.* at 5.

We do not find Appellants' evidence of unexpected results persuasive. "It is well established that the objective evidence of nonobviousness must be commensurate in scope with the claims." *In re Lindner*, 457 F.2d 506, 508, (CCPA 1972). We agree with Appellants that the Zhang Declaration establishes that the claimed organosilicon solvent alone provides greatly improved performance as compared to propylene carbonate alone. However, the claims require the combination of propylene carbonate with organosilicon solvent. Appellants have provided no evidence that an electrolyte made of the combination of propylene carbonate and organosilicon solvent provides a result that is different from the organosilicon solvent alone. Without such evidence, it is impossible to determine whether the results are synergistic. Moreover, consistent with the Examiner's position (Ans. 5), Rossi is the closest prior art against which a comparison should be made because it discloses the claimed organosilicon solvent.

Appellants further contend that the Specification itself discloses a synergistic effect. App. Br. 6–7, citing Spec. ¶¶ 24–25. We are not persuaded by Appellants' contention. The Specification contains only

conclusory statements about the effectiveness of the claimed invention unsupported by any evidence such as comparative experimental data. Specifically, the Specification states:

> It has been found that the use of an organosilicon compound as a co-solvent for propylene carbonate shows a significant synergic effect . . . The present inventors have found that surprisingly, organosilicon has a highly efficient performance in reducing the irreversible capacity at the anode side when PCbased electrolytes were used. . . . It has been observed that this mixture provides for an unexpected effect in lithium ion batteries employing such solvents exhibit improved capacity retention, thermal stability, and durability compared to lithium ion batteries employing only one of these materials.

Spec. ¶¶ 24–25. A showing of unexpected results must be based on evidence, not argument or speculation. *In re Mayne*, 104 F.3d 1339, 1343-44 (Fed. Cir. 1997) (conclusory statements that claimed compound possesses unusually low immune response or unexpected biological activity that is unsupported by comparative data held insufficient to overcome prima facie case of obviousness).

SUMMARY

We affirm the Examiner's rejection of claims 11 and 14–19 under 35 U.S.C. § 103(a) as unpatentable over the combination of Rossi and Sakata.

We designate our affirmance as a new ground of rejection pursuant to 37 C.F.R. § 41.50(b). 37 C.F.R. § 41.50(b) provides that "[a] new ground of rejection pursuant to this paragraph shall not be considered final for judicial review."

37 C.F.R. § 41.50(b) also provides that Appellants, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

> (1) *Reopen prosecution.* Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the proceeding will be remanded to the examiner . . . . or
>
> (2) *Request rehearing.* Request that the proceeding be reheard under § 41.52 by the Board upon the same record.

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

AFFIRMED

37 C.F.R. § 41.50(b)