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EXAMINER
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte S. ELANGOVAN and JOSEPH J. HARTVIGSEN

Appeal 2015-001035
Application 12/240,725
Technology Center 1700

Before CATHERINE Q. TIMM, ROMULO H. DELMENDO, and AVELYN M. ROSS, *Administrative Patent Judges*.

DELMENDO, *Administrative Patent Judge*.

DECISION ON APPEAL

The Applicants (hereinafter the "Appellants")[1] appeal under 35 U.S.C. § 134(a) from a final decision of the Primary Examiner to reject claims 1–10, 17, 19, and 28–30.[2] We have jurisdiction under 35 U.S.C. § 6(b).

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[1] The Appellants state that the real party in interest is "Ceramatec, Inc." (Appeal Brief filed May 27, 2014, as corrected on July 1, 2014, hereinafter "Appeal Br.," 4). In addition, the Appellants' Specification (hereinafter "Spec") states that "[t]he U.S. Government has certain rights in this invention as provided for by the terms of Small Business Innovation Research (SBIR) Contract No. FA8650-07-M-2704 awarded by the U.S. Air Force." (Spec. ¶ 2).

[2] Appeal Br. 1; Final Office Action mailed December 30, 2013 (hereinafter "Final Act.," 1.

We reverse.

BACKGROUND

The subject matter on appeal relates to a solid oxide fuel cell (SOFC) (Spec. ¶ 3). According to the Appellants, a conventional solid oxide fuel cell utilizes a yttria-stabilized zirconia (YSZ) electrolyte between a cathode (e.g., lanthanum strontium manganite or similar material) and an anode, which uses oxygen ions generated by the cathode to oxidize fuel, thereby resulting in free electrons at the anode (*id.* ¶ 4). The anode itself is described as being a ceramic/metallic (cermet) material including YSZ as the ceramic and nickel (Ni) as the metal (*id.*). The Appellants explain that sulfur, which is present in the fuel at high levels, can rapidly poison and deactivate the Ni-YSZ cermet anode (*id.* ¶ 5). The Appellants propose a solution to this problem by providing a solid oxide fuel cell including a sulfur tolerant anode in which YSZ is replaced with ceria (CeO_2) (i.e., doped ceria) (Spec. ¶¶ 10, 30, 36).

Representative claim 1 is reproduced from page 16 of the Appeal Brief, with the disputed limitations highlighted in italics, as follows:

> 1. A solid oxide fuel cell (SOFC) comprising:
> an electrolyte;
> a cathode disposed on a first side of the electrolyte; and
> a sulfur tolerant anode disposed on a second side of the electrolyte opposite the cathode, wherein the sulfur tolerant anode comprises a composition of nickel (Ni), copper (Cu), and ceria (CeO_2) to exhibit a substantially stable operating voltage at a constant current density in the presence of a fuel with a measurable sulfur content, *wherein there is no YSZ in the sulfur tolerant anode*.

Claim 19, the only other independent claim on appeal, also recites that "there is no YSZ in the sulfur tolerant anode" (Appeal Br. 18).

THE REJECTIONS

The Examiner rejected the claims under 35 U.S.C. § 103(a) as follows:

I. Claims 1–9, 19, and 30 as unpatentable over Hashimoto et al. (hereinafter "Hashimoto")[3] in view of H. Kim et al. (hereinafter "Kim");[4]

II. Claim 10 as unpatentable over Hashimoto in view of Kim and Elangovan et al. (hereinafter "Elangovan");[5]

III. Claim 17 as unpatentable over Hashimoto in view of Kim, Elangovan, and Keefer;[6] and

IV. Claims 28 and 29 as unpatentable over Hashimoto in view of Kim and Keefer.

(Examiner's Answer mailed August 26, 2014, hereinafter "Ans.," 2–8; Final Act. 2–11.)[7]

DISCUSSION

The Examiner found that Hashimoto describes a solid oxide fuel cell as recited in claim 1 except that the prior art anode includes nickel and ceria rather than nickel, copper, and ceria (Ans. 2). The Examiner found, however, that Kim discloses Cu-Ni alloys in ceramic-metal composites as

[3] US 6,287,716 B1, issued September 11, 2001.
[4] H. Kim, C. Lu, W. L. Worrell, J. M. Vohs, and R. J. Gorte, "Cu-Ni Cermet Anodes for Direct Oxidation of Methane in Solid-Oxide Fuel Cells," 149 *J. Electrochem. Soc.* A247–A250 (2002).
[5] US 6,099,985, issued August 8, 2000.
[6] US 2005/0106429 A1, published May 19, 2005.
[7] On page 8 of the Answer, the Examiner withdrew a rejection of claims 1–9, 19, and 30 under 35 U.S.C. § 103(a) as unpatentable over Kim in view of Hashimoto.

anodes for the direct oxidation of methane in solid oxide fuel cells (*id.*). The Examiner then concluded that

> it would have been obvious to one of ordinary skill in the art . . . to modify the Hashimoto fuel electrode [by replacing] Ni with a Cu-Ni alloy in order to greatly suppress carbon formation on the anode, thereby improving the performance of the fuel cell by providing a significant increase in power density with time

(*id.* at 2–3). The Examiner acknowledged that Kim discloses a solid oxide fuel cell that includes YSZ but found that the YSZ is disclosed as an electrolyte—not as part of the anode (*id.* at 9–11).

The Appellants contend that the Examiner failed to articulate a sufficient reason with some rational underpinning to support the obviousness conclusion (Appeal Br. 6–7). Specifically, the Appellants argue that, contrary to the Examiner's position, "Kim expressly indicates that the YSZ layer is a component of the anode" and that "Kim does specifically address functional contributions of the 'YSZ component of the anode' to the overall performance of the fuel cell as a whole" (*id.* at 8–9). The Appellants further argue that Hashimoto teaches away from a 3-phase interface or boundary region at the anode, as described in Kim (*id.* at 9–10).

We agree with the Appellants. Although Kim discloses a YSZ electrolyte (A247, left column; A250, Fig. 5), the Examiner has not directed us to sufficient evidence that YSZ is present only in the electrolyte and not in the anode. To the contrary, Kim indicates that YSZ is used to form a "porous anode layer" ("Experimental" section, A247, right column, first paragraph). Indeed, Kim makes clear that the anode, like the electrolyte, also contains YSZ by teaching that "increased porosities for the *YSZ component of the anode*, as well as higher metal contents, should decrease

the need for carbon to provide connectivity in the electronic component of anode" (A250, right column) (emphasis added). Moreover, Kim assumes from previous work by others that "'fingers' of YSZ from the electrolyte *extend into the anode region* to increase the transfer of O^{2-} ions" (*id.*, left column) (emphasis added) and, therefore, Kim's anode would in fact appear to include YSZ, contrary to the requirement that "there is no YSZ in the sulfur tolerant anode" specified in claim 1. Because the Examiner did not provide a sufficient rationale explaining why a person having ordinary skill in the art would have used Kim's anode material without any YSZ as the anode in Hashimoto, we cannot uphold any of the stated rejections.

SUMMARY

The Examiner's final decision to reject claims 1–10, 17, 19, and 28–30 is reversed.

REVERSED