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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/798,730	10/31/2017	HONG-YING FU	US62157	9824

54000 7590 08/27/2020

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EXAMINER
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ART UNIT	PAPER NUMBER
1783	

NOTIFICATION DATE	DELIVERY MODE
08/27/2020	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte HONG-TING FU and WEN-ZHEN LI

Appeal 2019-006408
Application 15/798,730
Technology Center 1700

Before JEFFREY B. ROBERTSON, N. WHITNEY WILSON, and DEBRA L. DENNETT, *Administrative Patent Judges*.

WILSON, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant[1] appeals under 35 U.S.C. § 134(a) from the Examiner's December 4, 2018 decision finally rejecting claims 1 and 3–10 ("Final Act."). We have jurisdiction over the appeal under 35 U.S.C. § 6(b).

We reverse.

[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies Tsinghua University and Hon Hai Precision Inc., Co. Ltd. as the real parties in interest (Appeal Br. 2).

CLAIMED SUBJECT MATTER

Appellant's invention is directed to a composite structure which comprises a porous metal structure and a carbon nanotube structure – comprising a plurality of carbon nanotubes – which is fixed on a surface of the porous metal structure (Abstract). The porous metal structure and the carbon nanotube structure are shrunk together to form a plurality of wrinkled parts (*id.*). Details of the claimed invention are described in claim 1, which is reproduced below from the Claims Appendix of the Appeal Brief:

> 1. A composite structure with porous metal comprising:
>
> a porous metal structure; and
>
> a carbon nanotube structure comprising a plurality of carbon nanotubes, the carbon nanotube structure is fixed on a surface of the porous metal structure, wherein the porous metal structure and the carbon nanotube structure are shrunk together to form a plurality of wrinkled parts.

REJECTIONS

1. Claims 1 and 3–6 are rejected under 35 U.S.C. § 103 as unpatentable over Farquhar[2] in view of Lin.[3]

2. Claims 7–9 are rejected under 35 U.S.C. § 103 as unpatentable over Farquhar and Lin, and further in view of Miller.[4]

3. Claim 10 is rejected under 35 U.S.C. § 103 as unpatentable over Farquhar and Lin, and further in view of Wei.[5]

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[2] Farquhar et al., US 2017/0145561 A1, published May 25, 2017.
[3] Lin et al., US 2017/0232725 A1, published August 17, 2017.
[4] Miller et al., US 2014/0151288 A1, published June 5, 2014.
[5] Wei et al., US 2016/0159651 A1, published June 9, 2016.

DISCUSSION

Appellant does not argue any of the claims separately (Appeal Br. 10). Accordingly, our analysis will focus on the rejection of claim 1 over Farquhar in view of Lin.

The Examiner finds that Farquhar discloses a graphene-metal composite comprising a porous metal foam substrate and a graphene layer deposited on the porous metal foam substrate by growing carbon nanotubes on the surface before compressing, where the multilayered porous metal foam substrate is compressed (Final Act. 3, citing Farquhar Abstract, claim 6). The Examiner also finds that Farquhar does not disclose that the metal structure and the nanotubes are shrunk together to form a plurality of wrinkled parts (Final Act. 3).

The Examiner also finds that Lin discloses wrinkled metal films for applications in electronics such as wearable devices, strain sensors, and capacitive sensors (Final Act. 3, citing Lin, Abstract). The Examiner finds that Lin discloses that the wrinkled metal thin films are fabricated by thermally shrinking shape-memory polymers patterned with metal, eliciting a stiffness mismatch and causing the metal film to buckle and form wrinkles, and that the thin profiles and flexibility make them more capable of conforming to the skin (Final Act. 3, citing Lin, ¶4).

The Examiner determines that it would have been obvious "for the compressing step of Farquhar to alternatively comprise shrinking the metal composite in order to form a wrinkled surface useful for applications in electronics such as wearable devices, strain sensors, and capacitive sensors" (Final Act. 4).

Appellant argues that Farquhar achieves increased conductivity of its graphene-metal composite by closing voids in the composite by compression and creating "an electrical super highway" (Appeal Br. 6, citing Farquhar, ¶¶ 33 and 40). Thus, according to Appellant, the compression step taught by Farquhar increases the density of the composite and changes its internal structure (Appeal Br. 6). Appellant further argues that in Lin's system the shape of the thin metal films is changed by the shrinkage, but the internal structures of the thin metal films are not changed (Appeal Br. 6–7). Appellant illustrates these arguments using the following figures:

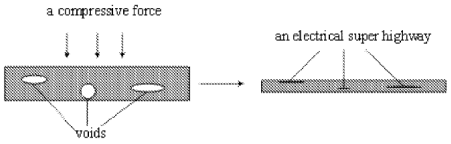

Figure 1

Figure 2

Appellant's Figures 1 and 2 illustrate its argument about the different effects of Farquhar's compression step and Lin's shrinking step.

Appellant argues that a person of ordinary skill in the art would not have substituted Lin's shrinkage step for Farquhar's compression step because the shrinkage step does not change the internal structure of Lin's composition, and thus would not close Farquhar's internal voids and create the electrical superhighway sought by Farquhar.

This argument is not persuasive, essentially for the reasons set forth by the Examiner at page 4 of the Answer. In particular, the Examiner finds that Lin teaches that its thin film is shrunken, not merely wrinkled (Ans.4, citing Lin ¶ 4). A person of skill in the art would have understood that

"shrink" means a reduction in size, not merely a change in shape. If the overall size of the film is smaller, it would have suggested to a person of skill in the art that voids in the film would also be smaller, as required in Farquhar's composition.

Appellant also argues that the shrinkage described by Lin applies to the aspect ratio of its wrinkles (Appeal Br. 7–8, citing Lin, ¶ 6). However, while Lin does explain that the shrinkage does produce higher aspect ratio wrinkles, Lin explicitly states that it is the film itself which is shrunk by amounts greater than 300% (Lin, ¶6).

Appellant further argues that Lin's composition is thousands of times thinner than Farquhar's composition and, therefore, a person of skill in the art would not have expected that a process which shrinks Lin's metal films would be able to compress Farquhar's metal foam and close its internal voids (Appeal Br. 9–10). This argument is persuasive. The Examiner has not provided persuasive evidence that a person of skill in the art would have expected that the forces provided by Lin's shape memory polymers to shrink and wrinkle Lin's thin metal films would have been sufficient to compress Farquhar's (relatively) thick graphene-metal composites.

Accordingly, we reverse the rejections.

CONCLUSION

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1, 3–6	103	Farquhar, Lin		1, 3–6
7–9	103	Farquhar, Lin, Miller		7–9
10	103	Farquhar, Lin, Wei		10
Overall Outcome				1, 3–10

REVERSED