



US 20230231273A1

(19) **United States**(12) **Patent Application Publication**
Takeda et al.(10) **Pub. No.: US 2023/0231273 A1**(43) **Pub. Date: Jul. 20, 2023**(54) **IMPROVED MICROPOROUS MEMBRANE
AND DEVICES COMPRISING THE SAME****Publication Classification**(71) Applicants: **Celgard, LLC**, Charlotte, NC (US);
ASAHI KASEI KABUSHIKI
KAISHA, Tokyo (JP)(72) Inventors: **Hisashi Takeda**, Düsseldorf (DE);
Kang Karen Xiao, Mississauga (CA);
Allen M. Donn, Rock Hill, SC (US);
Shinya Hamasaki, Tokyo (JP); **Masaki**
Takahashi, Tokyo (JP)(51) **Int. Cl.****H01M 50/457** (2006.01)**H01M 50/403** (2006.01)**H01M 50/417** (2006.01)**H01M 50/489** (2006.01)**H01M 10/42** (2006.01)**H01M 50/434** (2006.01)(52) **U.S. Cl.**CPC **H01M 50/457** (2021.01); **H01M 50/403**
(2021.01); **H01M 50/417** (2021.01); **H01M**
50/489 (2021.01); **H01M 10/4235** (2013.01);
H01M 50/434 (2021.01)(21) Appl. No.: **18/009,342**(22) PCT Filed: **Jun. 11, 2021**(86) PCT No.: **PCT/US2021/036991**

§ 371 (c)(1),

(2) Date: **Dec. 9, 2022****Related U.S. Application Data**(60) Provisional application No. 63/038,555, filed on Jun.
12, 2020.

(57)

ABSTRACT

A multilayer porous membrane with two exterior layers and at least one interior layer. The average pore size of the interior layer is greater than that of either of the two exterior layers. The multilayer porous membrane may be used, for example, as or as part of a battery separator. Compared to prior multilayer porous membranes for battery separators, the multilayer porous membrane herein may exhibit at least one of improved thermal properties, improved anti-metal contamination properties, improved ease of manufacture, and combinations thereof.

