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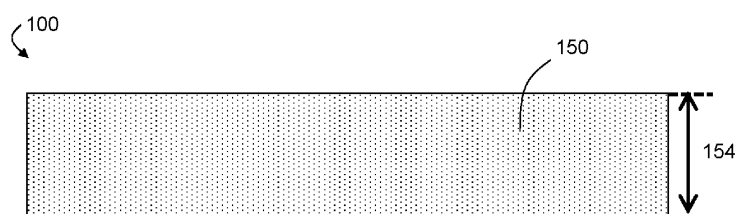


FIG. 1A

(57) Abstract: Cation exchange membranes and materials including silica-based ceramics, and associated methods, are provided. In some aspects, cation exchange membranes that include a silica-based ceramic that forms a coating on and/or within a porous support membrane are described. The cation exchange membranes and materials may have certain structural or chemical attributes (e.g., pore size/distribution, chemical functionalization) that, alone or in combination, can result in advantageous performance characteristics in any of a variety of applications for which selective transport of positively charged ions through membranes/materials is desired. In some embodiments, the silica-based ceramic contains relatively small pores (e.g., substantially spherical nanopores) that may contribute to some such advantageous properties. In some embodiments, the cation exchange membrane or material includes sulfonate and/or sulfonic acid groups covalently bound to the silica-based ceramic.

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