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Nanostructured, porous palladium alloys from consolidation of dendrimer encapsulated nanoparticles for hydrogen isotope separation and storage

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Due to its high surface area and correspondingly rapid kinetics, nanoporous palladium is a promising material for chromatographic separation and storage of hydrogen isotopes. In the case of tritium storage, it has been hypothesized that pores should mitigate nucleation of helium-3 bubbles arising from tritium decay. A technique for preparing nanoporous palladium alloys based on partial consolidation of dendrimer encapsulated nanoparticles (DEN) will be presented. Destabilization of a colloidal suspension of DEN and purification yields a high surface area material with pore diameters between 20 and 200 nm. Compared to other aqueous chemical reduction methods, this approach has the advantage of compositional uniformity that is tunable based on the composition of the DEN. Nanoporous $Pd_{0.9}Rh_{0.1}$ alloys with uniform composition or with Rh enrichment at pore walls and grain boundaries have been prepared and characterized. Their hydrogen and deuterium storage properties were evaluated and compared to nonporous $Pd_{0.9}Rh_{0.1}$ powders. In addition, the materials have been demonstrated to be thermally stable by microscopic and bulk techniques, with high surface area and pore structure retained to 300-400°C.

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