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P3.167 Tritium separation via high-temperature proton-conducting ceramic pumps

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This paper is aimed at addressing critical issues related to tritium separation in fusion reactors. One of the effective tritium separation technology is using high temperature proton conducting materials as hydrogen isotope separation membranes. When a direct current is applied to the electrochemical hydrogen pump, hydrogen and its isotopes in the anode side can be electrochemically extracted to the cathode side in spite of the chemical potential difference. A large one-end closed proton-conducting ceramic tube of CaZr0.9In0.1O3-α, which had the size of 19.6 mm in outer diameter, 17 mm in inner diameter and 520 mm in length, was used in this work. The porous Pt electrodes were attached on the inner (anode) and outer surface (cathode) of the tube by a pasting method, and its inner and outer length in axial direction was 520 mm and 400 mm from the closed end, respectively. When the supply gas containing 100 ppm and 0.85 V DC was applied to the hydrogen pump, almost all 100 ppm H2 in the anode gas has been entirely extracted, i.e., the hydrogen recovery efficiency was more than 99%, suggesting that the extraction of hydrogen could be operated with a current efficiency close to unity. The tritium extraction performance was also evaluated from a mixture of gases including 960.9 ppm hydrogen and radioactive tritium concentration of the order of 10 Bq/cm3 balanced with helium at 1023 K and applied 0.80V DC, which indicated that more than 31% of tritium supplied was recovered, and diffusivity of hydrogen in the proton conductor ceramic is larger than that of tritium.

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