Hydrogen-tritium Isotope Separation by CECE Process with a Randomly Packed LPCE Column

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Experimental studies on hydrogen-tritium isotope separation by a Combined Electrolysis Catalytic Exchange (CECE) process with a Liquid Phase Chemical Exchange (LPCE) column have been carried out in order to apply it to the system of water detritiation for fusion reactors.

The column was a Pyrex glass tube with 25 mm internal diameter and 1 m length. Kogel catalysts (4.0-6.7 mm spherical) of 30 volumetric percent and Dixon gauze rings (6 mm outer diameter, 6 mm high) of 70 volumetric percent were mixed and filled randomly in the column so that the catalysts distributed macroscopically homogeneously. The catalyst packed ratio, 30 %, was optimal in the sense of giving maximal separation factor and was obtained by the preliminary experiments. The solid polymer electrolysis (SPE) electrolyzer was manufactured by Showa Engineering Co. Ltd. The maximum production rate of hydrogen gas was 1 m^3/h. Experiments of hydrogen-tritium isotope separation using the CECE equipment were performed at 101 kPa, 343 K. The flow rate of hydrogen gas was selected to 5, 6 and 8 L/min and feed rate of water was adjusted, respectively, as the molar flow ratio of hydrogen gas to liquid water in the column became about 1.4. A separation factor of the column was defined by the ratio of the molar fraction of HTO in the liquid water at the bottom of the column to that of HT in the hydrogen gas at the top of the column, when the molar fractions were very small compared with unity. The determination of separation factor was carried out at the steady state. The gaseous samples were converted to liquids by a reactor packed with copper oxide at 623 K. The tritium concentrations in the liquid samples were measured by a liquid scintillation spectrometer (Aloka model LSC 5100). The separation factor increased when the flow ratio of hydrogen gas decreased. The maximum value of the separation factor was 19200 when the flow ratio of hydrogen gas was 5 L/min.