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P4.167 Mechanical design and first experimental results of a new multi-tube Pd-Ag membrane reactor for hydrogen isotopes separation in solid blanket concept of nuclear fusion machines

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Pd-Ag membranes are well-proven technologies in nuclear fusion fuel cycle. Membrane technologies are one of the reference processes in the tritium extraction and recovery system of DEMO helium cooled pebble bed (HCPB) blanket. In the HCPB, a He + 0.1%w H2 purge gas is sent in the solid blanket in order to extract tritium. The result is a stream Q2 (Q = H, D, T) and Q2O species in a very low concentration and a huge amount of He purge gas. A pre-concentration stage allows to increase the Q2 and Q2O concentration while a following ultra-pure hydrogen isotopes separation will be performed via a Pd-Ag membrane module. For this reason, during the last few years, in the ENEA laboratories, a single-tube facility has been built and tested to assess the performances in hydrogen isotopes separation and water decontamination. In view of DEMO requirements, many efforts are now devoted to develop and optimise a scaled-up multi-tube membrane reactor aimed to perform both separation and reaction tests close by DEMO-relevant conditions. This work reports the mechanical design and optimization of a medium-scale (10-tubes) membrane reactor and the commissioning of a new facility built up in ENEA. In addition, the preliminary experimental results will be presented in this paper in order to investigate the behavior of the Pd-Ag membrane module by varying the main operating parameters (He/Q2 ratio, temperatures and pressures).

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