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P3.114 Instrument for hydrogen isotopes irradiation and resident assessment

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Tritium takes the most cost of fusion project when it has been regularly operated.In order to give a proper fuel combustion rate and recycling efficiency,it is necessary to assess the amount of hydrogen isotopes(accompanied with helium)retent in the plasma facing materials(PFM).
A comprehensive ECR plasma system for tritium (named CEPT)is designed and built for the assessment of tritium penetrating and resident in PFM(e.g. tungsten).ECR(electron cyclotron resonance)plasma can provide low pressure,high density,long-term stable irradiation of hydrogen isotopes.The typical irradiation parameter of hydrogen isotopes or helium plasma produced by CEPT is:3eV-7eV,1020D/(m2s)-1021D/(m2s),10-3Pa-1Pa, 0-100sccm.A farther 600V bias electric field can effectively accelerate the ions.Contrasting to the unstable arc discharging(which can provide higher parameters of ion flux but short-term stable working due to electrode material loss, higher fuel consumption) ,CEPT can meticulously produce hydrogen isotopes and helium flux on the PFM more than 12h continuously. CEPT mainly has a glow vacuum chamber, a plasma irradiation vacuum chamber, and a TDS (Thermal Desorption Spectroscopy)-LIBS (Laser Induced Breaking-down Spectroscopy) vacuum chamber. All of them can obtain 5.5×10-5Pa ultimate vacuum. The material samples can be water-cooled when facing the plasma irradiation.And the hydrogen isotopes resent in the sample can be analyzed online. The magnet field of the confined plasma is adjustable up to 2500 Gauss (water cooled coils).A Langmuir probe is used to diagnose the plasma density and energy.The radiation protection system was designed to ensure the safety of tritium operation.

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