HYDROGEN RETENTION IN GALLIUM SAMPLES EXPOSED TO ISTTOK PLASMAS

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Liquid metals have been pointed out as a suitable solution to solve problems related to the use of solid walls submitted to high power loads and allowing an efficient heat exhaustion process from fusion devices. The most promising candidate materials are lithium and gallium. The main advantage of gallium is its higher liquid state temperature range when compared with lithium. One of the crucial properties of plasma facing components are their ability to retain (or not) hydrogen. It has been shown [1] that liquid lithium is capable of retaining very large amounts of hydrogen by lithium hydrates formation (up to a 1:1 stoichiometric ratio). This effect has a deep influence on plasma behaviour by imposing a near to zero recycling operating conditions in tokamaks. As a consequence a significant improvement on performance has also been observed with a significant increase on the energy confinement time [2] with a broader plasma region available to fusion reactions since the edge plasma also achieves higher electron temperatures [3]. While retention in lithium has been studied in detail less is known for gallium. For the above mentioned reasons it is deemed important to perform such studies in tokamak plasmas.

The main objective of this work is to report on the measurements of in-depth hydrogen profiles that is retained in gallium samples (either solid or liquid) exposed to ISTTOK plasmas. ISTTOK is a large aspect ratio circular cross-section tokamak with main parameters: R = 46 cm, a = 8.5 cm, B_T = 0.5 T, $I_p \approx$ 4-6 kA.

Two different setups had to be implemented to duly expose gallium samples to the ISTTOK plasmas: i) a gallium sample preparation chamber and ii) a sample positioning and conditioning system. Several samples were exposed to a large number of ISTTOK discharges at different radial positions within the plasma edge. Similar plasma conditions and exposure times (3 s integrated time) were used during individual irradiations. The final sample hydrogen content achieved during this procedure was evaluated by means of ion beam analysis (ERDA). Retention data coming from a non-irradiated gallium sample was also obtained and used for comparison purposes. Obtained data shows that higher hydrogen retention is only observed across a thin layer near the gallium sample surface. Furthermore the amount of hydrogen increases within the liquid sample as it is placed at a deeper location into the plasma. Although the solid sample demonstrates higher hydrogen content, it is believed to be due to a different composition of the exposed surface.

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