Behaviour of liquid Sn and Sn-Li alloy as plasma facing materials on ISTTOK

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The high power loads impinging on the first wall and particularly the divertor of fusion reactors is a decisive factor to the success of nuclear fusion [1]. An alternative to solid plasma facing components is the use of liquid metals such as lithium, gallium or tin due to the regenerative properties of the liquid surface. However, the use of these materials in fusion reactors depends, among other factors, on the discharge performance degradation induced by the enhanced impurity contamination and on their affinity to retain hydrogenic isotopes. Comprehensive studies on gallium’s behaviour under tokamak conditions were made previously at ISTTOK. The results shown that this material was compatible with low hydrogen retention restriction and the infrastructure developed at ISTTOK to perform this task now allows the study of other liquid metals [2].

Samples of Sn and Sn-Li alloy [3] were recently exposed at ISTTOK to deuterium plasmas. The erosion of the samples is being studied via spectroscopic imaging of the Sn I and Sn II lines in the visible range for tin and Li I line at 670.7 nm for the alloy. Simultaneously, a pyrometer focused on the liquid metal surface monitored the sample temperature during the discharge. Posthumously the samples were brought to the Laboratory of Accelerators and Radiation Technologies where several ion beam diagnostics were applied. To quantify the fuel retention on the samples the nuclear reaction analysis (NRA) technique was applied. Complementary Rutherford backscattering spectrometry and particle-induced x-ray emission were used for accurate determination of stoichiometry and material composition (particularly of impurities) of the samples.

Finally, the deuterium retained fraction in the exposed samples was determined. Further experiments must be performed, however present results are compatible with their implementation as plasma facing materials.

References: