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Surface Characterization of Li coatings and their interaction with plasmas for fusion applications via Ion Beam Analysis Techniques

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Conditioning of Plasma Facing Components (PFC) is a common practice to improve the plasma performance in both tokamaks and stellarators. The evaporation of thin Li films on the PFC and first wall has given positive results in multiple machines (CDX-U, LTX, TFTR, NSTX, EAST). Reduced recycling and impurity concentration in the plasma are commonly associated with Li. As a consequence, improved energy confinement times and increased stored energy have been observed, in addition to the reduction of Edge Localized Modes (ELMs) frequency.

As a consequence, multiple studies have been dedicated to investigate the surface properties of Li and its interaction with species that are common in fusion environments e.g. H, D, O. As the Plasma Material Interactions (PMI) occur near the surface of the PFC (top 10-100 nm), methods with such probing depths, such as Ion Beam Analysis (IBA) techniques, are a remarkable resource to characterize these materials and the effect that plasmas have on them.

The Dynamics of ION Implantation and Sputtering Of Surfaces (DIONISOS) is an in-situ PMI facility, designed to expose samples to plasmas and interrogate their surfaces using IBA. The experiment is equipped with a helicon plasma source that can produce discharges with fluxes near 1021m-2s-1 and electron temperatures close to 6 eV. DIONISOS is attached to an ion accelerator, allowing execution of Elastic Recoil Detection (ERD), Rutherford Backscattering Spectroscopy (RBS), and Nuclear Reactions Analysis (NRA). Recently, the facility has been equipped with a Li evaporation system for in-situ deposition of thin films on the substrates. The combination of modification and analysis tools available in DIONISOS, makes it ideal to study the dynamic and multivariable relationship of Li and plasmas.

This work includes real time ERD and RBS data collected during deposition and erosion of thin Li films applied on different substrates. Various substrates have been used for characterization of the deposited films preparing to study the interaction of Li with materials relevant to fusion applications. In the same way, several experimental parameters have been optimized for better quantification of the relevant species.

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