EFFECT OF SURFACE OXIDATION AND TEMPERATURE IN THE ELECTRON-INDUCED SECONDARY ELECTRON EMISSION OF LITHIUM IN A CAPILLARY POROUS SYSTEM.

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In fusion plasmas the particle and heat loads that plasma-facing materials undergo upon exposure to the plasmas can be very sensitive to their actual value of the electron-induced Secondary Electron Emission (SEE) parameter. For a SEE yield of unity, a full suppression of the plasma sheath takes place. This will reduce the ion energy to twice the ion temperature, Ti, as compared to the typical value of five times Ti for hydrogen ions in the presence of the sheath. However, this reduction is overcompensated by the sharp increase of heat fluxes due to the electron bombardment. As lithium is foreseen as a possible candidate for its use in the divertor of DEMO in a capillary porous system (CPS) the SEE in this configuration is of great interest. In previous studies an anomalous enhancement of the SEE of Li compared with theoretical value was found. Nevertheless, it was not clear if the higher values were related to the oxidation and surface composition of the Li surface [1] or to the possible effect of the plasma exposure [2].

In order to clarify this and get a deeper understanding of the observed increased SEE in the present work, the method used to measure SEE in plasma DC-Glow discharges in [2] is used to study the effect of oxidation (from residual gas and O₂ injection) and temperature in the SEE of a CPS wetted with Li. The target used for the experiments is a cylindrical electrode (which can be heated up to 700 °C) covered by a SS mesh (about 20 μm effective porous size) wetted with Li and covered except for its tip with a ceramic in order to have a planar geometry exposed to plasma (cylindrical geometry was found to be affected by the change in sheath thickness with bias).

After exposure to air atmosphere (10s) and residual gas (more than 48h) high values of SEE (around 2) are observed for temperatures under 400 °C and a decrease to lower values, around 0.8 (similar to theoretical values) are found when the electrode is heated to temperatures above 400-450 °C. Subsequent exposure to 0,1mTorr O₂ molecular gas produces a progressive increase of the SEE coefficient up to values around 2. Thus, the oxygen content of the surface seems to be responsible for the increase of SEE observed in lithium, although exposure to vacuum (3.10⁻⁷ Torr) for 1h at RT is enough to produce this high SEE values. These results point to a possible diffusion mechanism for oxygen from the surface to the Li bulk, driven by the increase of solubility of O in Li with temperature and resulting in a depletion of oxygen at the surface, which restores the SEE properties of clean Li.