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Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

ENHANCED DESORPTION FROM SOLID DEUTERIUM DRIVEN BY CHARGING WITH keV ELECTRONS

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Films of solid deuterium at a temperature around 3 K have been irradiated by 1.5 or 2 keV electrons. The films were deposited on the silver electrode of a quartz crystal microbalance (QCM) suspended below a pumped liquid helium cryostat [1,2]. The thickness of the films ranged from 10 nm to up to 5 μm. The initial film thickness and the mass loss as result of desorption were monitored by the QCM. The electron beam current was kept at about or below 100 nA to avoid beam-induced evaporation.

Secondary electron emission was suppressed to a value below 0.01-0.03 electrons/electron by a repeller ring at a bias of – 90 V. However, for films thicker than 3-4 times the range of the bombarding electrons, the electron yield suddenly rose to a value close to 0.40. From this secondary electron yield the voltage potential could be determined unambiguously from secondary electron emission curves obtained by short pulse measurements on fresh films. For the thickest films the charging induced a surface potential of more than 1.0 kV, i.e. one-half of the energy of the bombarding electron. For these thick films the desorption yield increased from the minimum value of 6-10 D_2/electron up to 380 D_2/electron at 1.5 keV and 960 D_2/electron at 2 keV.

The surface potential is induced by electron charge accumulation in the film at large thicknesses from where the electrons no longer are able to migrate to the conductive substrate with a sufficiently high rate.

References:

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