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Experimental and numerical study of sub-monolayer deposition of Ti on Si.

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The sticking and reorganization of atoms at the surface and in the sub-monolayer range is of great importance in the field of plasma surface treatments. Indeed, the first monolayers define the interface structure and properties between deposited layer and substrate as well as the adhesion of this deposited layer on the substrate. In plasma deposition techniques, the balance between sputtering and deposition of matter is governed by the species in the plasma as well as their distributions of impact energy and incidence angle on the substrate. However, these parameters are difficult to study by plasma deposition techniques.
In this presentation, we have used the Storing Matter technique[1,2] for the preparation of sub-monolayer films and secondary ion mass spectrometry (SIMS) for the analysis. First, the experimental method including the Storing Matter instrument will be described. Next, results on Ti deposition will be presented. Ti samples were sputtered by a 10keV Ar^+ beam with different primary ion fluences. The emitted Ti ions were collected on dedicated Si/SiO_2 collectors in the sub-monolayer range. Film thickness was calibrated versus deposition conditions to get ideas about the sticking behaviour of the matter: deposits have a Gaussian shape with a width at half maximum varying from 2500µm to 3000µm. Deposit height and coverage will be given in the presentation.
Experimental results are compared to molecular dynamics (MD) simulations using a level-three force field capable of modelling the breaking and formation of bonds. Continuous Ti deposition gives insight into the adhesion, implantation or backscattering of deposited Ti atoms with surface coverage. The sticking coefficient depends on deposition energy and angle, but in average it is close to 90%.
Reference List
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2. C. Mansilla and T. Wirtz, Surf. Interface Anal. 42, 1135 (2010).

Keywords
sticking, sputter deposition, storing matter, MD simulations