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Elementary mechanisms of target poisoning during reactive sputtering

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Particle beam experiments were conducted to study surface processes during target poisoning of an aluminium target as it occurs during alumina deposition by reactive magnetron sputtering. Oxygen and aluminium atom beams and a plasma ion gun were focused on an aluminium target. The fluxes of the particle beams were quantified and independently controlled. The ion flux was set to the range of 10^{14} - 10^{15} cm^{-2} s^{-1} as measured by a Faraday Cup. On the other hand, an effusion cell provided Al vapour during the experiments to restore the initial metal layer. The growth and etch rate were monitored in real time by means of a quartz crystal microbalance (QCM). The study of ion-enhanced oxidation of aluminium targets during reactive sputtering was performed by bombarding an Al-coated QCM with argon ions (400-800eV) and oxygen molecules. Sputter yields of the Al target were evaluated by measuring the mass uptake/removal from the QCM. Additionally, measurements with in-situ Fourier-Transform-Infrared Spectroscopy (FTIR) monitored in real time the surface modification of the Al-O bonds. The surface processes of the target were modelled by a set of rate equations, which related the surface coverage fraction with sputter yields, sticking coefficients and fluxes of the involved particles.

Keywords
particle beams
target poisoning
Aluminium oxide
reactive sputtering
Ar+O+Al