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Energetic contributions at the substrate in various regimes of reactive magnetron sputter deposition

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Energy transfers between plasmas and surfaces is of major importance for many plasma -based material modification processes, including magnetron sputter deposition. It is well known that the global energy deposited during the growth determines the features of the deposited film, such as its phase constitution, micro-structure, morphology etc., and, consequently, its final properties. Beyond this, the knowledge of the energetic contributions, and especially in the case of reactive sputtering, of the energetic species interacting with the substrate would give some interesting insight into the elementary mechanisms involved in the deposition process itself, and even in the sputtering one taking place at the target. We have previously shown that the evolution of the energy flux at the substrate can be fruitful to study reactive deposition processes [1].
In this contribution real time energy flux measurements performed with a thermopile-based diagnostic will be compared to energy-resolved mass spectrometry data recorded during reactive sputtering of various metal targets in Ar/O_2 gas mixtures. Our aim is to evidence the reactive species created in so called “metal” and “oxide” modes, as well as during the transitions step, that transfer energy to the substrate. Measurements are carried out on metals exhibiting various properties expected to influence the sputtering process and the formation of oxidized species like: oxide stability (or affinity with oxygen), secondary electron emission coefficient, sputtering yield, etc. The role that energetic O^- could play on the oxide film growth will be especially addressed.
[1] A.L. Thomann , P.A. Cormier, V. Dolique, N. Semmar, R. Dussart, T. Lecas, B. Courtois, P. Brault, Thin Solid Films 539 (2013) 88–95

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