

OR1208

Hysteresis-free HiPIMS deposition of high-index optical coatingsMatej Hala¹, Jiri Capek¹, Oleg Zabeida¹, Jolanta E. Sapiuha¹, Ludvik Martinu¹¹Ecole Polytechnique Montreal, Montreal (QC), Canada

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High Power Impulse Magnetron Sputtering (HiPIMS) and its recent modification called Modulated Pulse Power Magnetron Sputtering (MPPMS) are new deposition techniques that are currently being investigated for their promising potential to produce high-quality optical films. In this contribution, we investigate the behaviour of HiPIMS and MPPMS discharges operated in reactive mixtures of Ar and O₂, and compare them to a standard DCMS reactive process.

We demonstrate that in reactive O₂/Ar gas mixtures the surface metal oxides are effectively sputter-eroded from the target during both HiPIMS and MPPMS pulses, as indicated by detailed time-resolved optical emission spectroscopy and waveform analysis; this results in discharges operation in the transition mode between metallic and poisoned target surfaces. Stable deposition conditions and complete hysteresis suppression are thus obtained for a wide range of discharge parameters; examples are shown for Nb₂O₅ and Ta₂O₅ films exhibiting a high index of refraction, low absorption and a high deposition rate. This opens possibilities to fabricate optical coatings without need for a sophisticated reactive gas flow control, in contrast to reactive DCMS.

Keywords

high power impulse magnetron sputtering (HiPIMS)
reactive sputtering
optical emission spectroscopy
optical coatings
hysteresis