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# A new reactive high-power impulse magnetron sputtering plasma discharge model

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High-Power Impulse Magnetron Sputtering (HiPIMS) is a promising deposition technique. However, the physical mechanisms operating in the HiPIMS plasma are still far from being completely understood. This issue is even more pronounced when adding reactive gases, which lead to loss of process stability, coupled with process hysteresis, reduced deposition rates, as well as generation of detrimental energetic negative ions. In this contribution we try to tackle these challenges through computational modeling benchmarked with experimental plasma characterization. The aim is to understand the interaction between the physical and chemical mechanisms that operate in the bulk plasma and the coupling with surface reactions. A new time-dependent, volume averaged plasma chemical model for reactive HiPIMS called R-IRM has been developed. It calculates the time evolution of neutral and charged species in the dense plasma region in the vicinity of the cathode. The main idea of the model is to neglect the complexity which arises when spatial variations are considered, while at the same time include a sufficiently large number of reactions in order to model a HiPIMS plasma with limited computing power. As a first case study we explore the influence of oxygen dilution on the discharge properties of a Ti-O process in $Ar/O_2$ atmosphere. Trends and changes in electron density and energization, the ionization fraction of the sputtered vapor, and the oxygen dissociation fraction have been analyzed. Striking differences between the metal and poisoned modes will be highlighted and discussed in terms of internal process mechanisms.

**Keywords**
HiPIMS
plasma modeling
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