Dynamics of the sputtering target surface evolution in reactive HiPIMS

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Reactive High Power Impulse Magnetron Sputtering is a promising deposition technique with many interesting properties. Because of the high plasma densities and dynamic nature of the process, many basic aspects of the ongoing physical processes are still unclear. In this contribution, we study the evolution of the target surface composition in reactive HiPIMS. Using Ti and Al targets in Ar+O₂ and Ar+N₂ mixtures, the formation and removal of the corresponding compound at the surface is determined from the time evolution of discharge current waveforms. For comparison, pulsed DC process is also analysed.

Our results show that the ion dose, required to remove the compound from a poisoned sputtering target, is at least 10 times higher in HiPIMS as compared to pulse DC sputtering. Although the compound removal is comparable for both O and N, target poisoning is much slower in the Ar+N2 atmosphere. The slow cleaning in HiPIMS cannot be explained by sputtering only, as evaluated with simulations using the code TRIDYN. In addition to surface effect, significant fraction of the sputtered reactive gas is “recycled” in the HiPIMS discharge and returns back to the target surface. Because the ultimate goal is to provide a reliable description of the sputtering dynamics, the sputtered flux is analysed by mass spectroscopy.

Keywords
HiPIMS
Reactive sputtering
Ion-surface interaction