Reactive High-Power Impulse Magnetron Sputtering: plasma diagnostics and thin film synthesis (Invited talk)

Stephanos Konstantinidis*†[1]

[1]University of Mons (UMons) – Laboratoire de Chimie des Interactions Plasma-Surface University of Mons Avenue Copoernic, 1 7000 Mons, Belgium

Abstract

High-power Impulse Magnetron Sputtering is a technology that belongs to the field of Ionized-Physical Vapor Deposition of thin films. A metal target, the cathode of the system, is bombarded by plasma ions. Consequently, metal atoms are sputtered in the dense plasma. In HiPIMS, the energy is delivered to the plasma through high-voltage electrical pulses. Typical peak discharge currents and power densities are in the range of A/cm2 and kW/cm2, respectively. These values are 2 – 3 orders of magnitude higher than during conventional DC Magnetron Sputter (DCMS) deposition processes. In this situation, the ionization degree of the metal atoms – the film-forming species - is significantly amplified and film growth is assisted by an intense ion bombardment. The roperties of the film synthesized with an HiPIMS plasma are modified. The coatings exhibit different crystal phases, enhanced adherence, increased density, ... In this contribution, we show how plasma diagnostic tools might be used in order to get better insight on the physical phenomena underlying the plasma-surface interaction during HiPIMS discharges. Among other diagnostic techniques, a heat flux sensor was utilized in order to quantify the total energy flux (EF) delivered to the substrate surface. From these measurements carried out in Ar and Ar/O2 atmospheres, it can be learned that the EF normalized with respect to the film growth rate increases significantly as the glow discharge is operated in the oxidized regime i.e. when the metal target is covered by an oxide layer. The EF is increased further as a HiPIMS generator replaces the conventional DC power supply. Finally, the relationship between the plasma parameters, the plasma chemistry, the EF at the substrate, and the properties of the film is examined.

Keywords: HiPIMS, diagnostic, thin film, oxide

*Speaker

†Corresponding author: stephanos.konstantinidis@umons.ac.be