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## Mass spectrometry diagnostics in highly ionized plasma: A key tool to optimize the sputtering process and the film growth

Julien Keraudy University of Nantes, France

High power impulse magnetron sputtering (HiPIMS) is a new method for physical vapor deposition (PVD) based on magnetron sputtering. It utilizes transient impulse (short pulse) glow discharges with very high power and current density (up to 3 kW cm<sup>-2</sup> and 4 A cm<sup>-2</sup> respectively at a duty cycle of < 5%). Under these conditions the plasma density near the target increases sufficiently to ionize a significant proportion of the sputtered metal ions thus creating a high-efficiency metal ion source. Compare to conventional processes, HiPIMS discharges give increased possibilities to use ionized the metal flux for bombardment but have also demonstrated to be an elegant solution for controlling the chemical composition, energy and trajectory of the ion current arriving at the film growth surface. This fine control of the metal ion flux has found plenty of applications for cutting tools, especially for deposition on complex geometries, enhancement of the adhesion between coatings and substrates, enhancement of nitride coatings on MgO substrates. These achievements have mainly been possible thanks to a detailed comprehensive study of the plasma-surface interaction phenomena, especially at the plasma-growing film interfaces. Among the most common plasma diagnostic methods, mass spectrometry is proven to be a powerful tool to monitor the ion dynamics in HiPIMS discharges by examining the ion energy distribution function (IEDF). Through the presentation of different examples of innovative coatings as well as low-temperature epitaxial growth, the benefits of mass spectrometry in highly ionized plasma will be presented.

## **Biography**

Julien Keraudy was born in Brest, France, in 1989. He received the M.Sc. degree in physics and the Magister science from the University of Rennes, Rennes, France, in 2012, and the Ph.D degree in physics from the University of Nantes, Nantes, France in 2015. He is currently a Post-Doctoral Fellow in the division of Plasma & Coatings physics, Department of Physics, Chemistry and Biology (IFM), Linköping University, Sweden, where he is involved in plasma diagnostic and growth of thin films deposited by HiPIMS discharge.

julien.keraudy@liu.se

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