Monday Afternoon, April 20, 2026

Keynote Lectures

Room Town & Country A - Session KYL1-MoKYL

Keynote Lecture I

Moderator: Sandra E. Rodil, Universidad Nacional Autónoma de México

1:00pm **KYL1-MoKYL-1 HiPIMS with Cathode Reversal -- Physics and Applications***, David N. Ruzic [druzic@illinois.edu], Tag Choi, Nicholas Connolly,* University of Illinois at Urbana-Champaign, USA **INVITED**

This talk covers the physics behind, and applications of a high-power impulse magnetron sputtering (HiPIMS) deposition system which allows for the potential of the cathode to be reversed at the end of magnetron pulse.Results from a system which allows for detailed waveform control was first published [1], commercialized [2] and patented [3] at Illinois and has been the subject of numerous investigations. Reversing the cathode potential at the end of a high-power impulse magnetron sputtering (HIPIMS) pulse first turns the magnetron into a Hall-thruster expelling ions and plasma, and then raises the plasma potential allowing the control of the ion energy during the kick to within one eV -- even on insulating substrates. In addition, we will show that the ratio of target ions to gas ions can be controlled by changing the angle of the target with respect to the workpiece. Time-resolved Langmuir probes have been used as a function of position to show how the electron energy distribution evolves from a Maxwellian during the main negative pulse, to a Druyvesteyn during the delay before reversal, and to sub-Druyvesteyn during the positive pulse. The commutation of the potential to the workpiece happens on the micro-second timescale and the attendant dV/dx heats the local electron population leading to enhanced ionization and therefore higher deposition rates. By running the appropriate waveform, a PVD tool can be used as an etcher.These abilities open a wide range of applications for such devices from the ability to make conformal super-conducting films, corrosion barriers for bipolar fuel cell plates, more efficient CIGS solar cells, reduced-stress coatings and room-temperature high-hardness TiN thin films.

[1] Wu B, Haehnlein I, Shchelkanov I, McLain J, Patel D, Uhlig J, Jurczyk B, Leng Y and Ruzic D N, “Cu films prepared by bipolar pulsed high power impulse magnetron sputtering” *Vacuum* **150** 216–21 (2018)

[2] Starfire Industries LLC http://starfireindustries.com

[3] US Patents #11,069,515 B2 and #12,211,680 B2

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