

# 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

# Wednesday Afternoon, April 22, 2026

## Keynote Lectures

### Room Town & Country A - Session KYL2-WeKYL

#### Keynote Lecture II

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

1:00pm KYL2-WeKYL-1 **Nanoengineered Materials and Coatings for Medicine and Beyond**, *Krasimir Vasilev* [[krasimir.vasilev@flinders.edu.au](mailto:krasimir.vasilev@flinders.edu.au)], Flinders University, Australia

**INVITED**

In this keynote talk, I will give an overview of recent progress from my lab on development of plasma polymer facilitated nanoengineered surfaces and materials that benefit many areas of application. Over the years, we developed a range of plasma-based methods with allows us to control that entire spectrum of material surface properties, including chemical, physical, mechanical and topographical. The main focus of our research is the design and surface modification of novel medical devices and biomaterials for applications in areas such as tissue engineering, controlling inflammation and infections, drug delivery and medical diagnostics. However, our surface modification technologies are not limited to medicine. We have demonstrated the utility of nanoengineered plasma polymers for solving problems in other areas such as environmental science and remediation, water treatment and even wine making. I will present the engineering and chemical concepts underpinning “plasma nanoengineering” and give a range of examples of application of the technology in various fields, including commercial applications.

# Thursday Afternoon, April 23, 2026

## Keynote Lectures

### Room Town & Country B - Session KYL3-ThKYL

#### Keynote Lecture III

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

12:40pm KYL3-ThKYL-1 **Compressive Stress as Creative Force: Engineering Ultrahard Hydrogen-Free Carbon for a Diamond-Like Properties**, *David R. McKenzie* [[david.mckenzie@sydney.edu.au](mailto:david.mckenzie@sydney.edu.au)], University of Sydney, Australia **INVITED**

Hydrogen-free amorphous carbon films, which I first termed as "tetrahedral amorphous carbon (ta-C)", which my colleagues recently colloquially termed 'McKenzie Material' in recognition of my early identification and continued research of this metastable phase, exhibit extreme hardness, chemical inertness, optical transparency and tunable electronic properties. These properties are all attractive for tribological coatings, biomedical implants and microelectronic devices. Despite these advantages, scalable synthesis of dense,  $sp^3$ -rich films with sufficient thickness and adhesion has long been limited by intrinsic compressive stress and shortcomings of conventional deposition methods. Here I review recent advances in high-power impulse magnetron sputtering (HiPIMS) and its advanced variants that include mixed-mode, bipolar, hybrid-arc and multi-pulse configurations that achieve  $sp^3$  fractions exceeding 80 %, hardness approaching 75 GPa and markedly reduced noble-gas incorporation. Precise control of pulse parameters, substrate bias and sputtering atmosphere enables tailored ion energy and flux, promoting dense tetrahedral bonding while suppressing macroparticle contamination and micro-arcng. I highlight with insights from state of the art molecular dynamics how stress generation and relaxation mechanisms operate, including sublayer implantation combined with intermittent thermal or excimer-laser annealing to relieve multi-gigapascal compressive stresses without compromising  $sp^3$  content. Integrated strategies enable the deposition of adherent,  $\mu\text{m}$ -thick ta-C coatings on diverse substrates, facilitating industrial-scale deployment in wear-resistant tooling, biocompatible surfaces, and energy systems. The synergy of HiPIMS processes with targeted stress-management protocols establishes hydrogen-free amorphous carbon as a versatile platform for next-generation ultrahard, functional thin films.

## Author Index

**Bold page numbers indicate presenter**

— C —

Choi, Tag: KYL1-MoKYL-1, **1**  
Connolly, Nicholas: KYL1-MoKYL-1, **1**

— M —

McKenzie, David R.: KYL3-ThKYL-1, **3**

— R —

Ruzic, David N.: KYL1-MoKYL-1, **1**

— V —

Vasilev, Krasimir: KYL2-WeKYL-1, **2**