JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Kolloquium des
Zentrums für Materialforschung (LaMa)

Applications of Plasmas in Materials Research

Freitag, 27. April 2018
Hörsaal C 5a, neue Chemie, Heinrich-Buff-Ring 19

14:00 Uhr *Dr.-Ing. Ralf Bandorf*
Fraunhofer-Institut für Schicht- und Oberflächentechnik (IST), Braunschweig
High Density Plasmas for advanced Coatings

15:00 Uhr Break with Coffee and Cake

15:30 Uhr *Dr. Angela Kruth*
Leibniz-Institut für Plasmaforschung und Technologie e.V. (INP), Greifswald
Plasma-enhanced Synthesis of Nanomaterials for Future Energy Technologies

Gäste sind herzlich willkommen!

Die Dozenten des Zentrums für Materialforschung

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High density plasmas for advanced coatings

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Surface Engineering is the key technology for modifying the surface of work pieces to create added value. Numerous products benefit from tailored coatings to improve or just enable the function provided. Everyday life uses thin films in all areas ranging from scratch protection of glasses, diesel injection in automotive applications, architectural glazing, smart phones and multimedia, … and many more. Still the quest is for further improvement of existing products as well as opening up new application fields.

High density plasmas offer the chance to substantially improve coating properties or open up completely new functions. Using a high degree of ionization in film formation provides additional energy for the growing film. This will result in improved crystallinity, higher density, harder coatings, higher refractive index, and more. Within this talk gas flow sputtering GFS as a representative for hollow cathode processes [1,2], and high power impulse magnetron sputtering HIPIMS will be presented as representatives of high density PVD processes [3]. Furthermore microwave plasmas MW as PECVD processes [4] with high density plasma will be complementing the selection. The focus will be on the technologies and the advancement of coating properties using these high density plasmas. Also an outlook on the industrial use of the technologies will be given.

REFERENCES:

[1] T. Jung, “High rate deposition of alumina films by reactive gas flow sputtering”, Surf. Coat. Technol. 59 (1993) 171

[2] H. Sakuma, “Gas flow sputtering: Versatile process for the growth of nanopillars, nanoparticles, and epitaxial thin films”, Journal of Magnetism and Magnetic Materials, Volume 321, Issue 7, 2009, 872

[3] R. Bandorf, “High power impulse magnetron sputtering – HIPIMS”, in: Cameron, D.; Hashmi, S.: Comprehensive materials processing. Vol.4: Films and coatings. Technology and recent development, Elsevier, 2014, 75

[4] I. Ganachev, “Advanced large-area microwave plasmas for materials processing”, Surf. Coat Technol. 174 – 175 (2003) 15

Plasma-enhanced Synthesis of Nanomaterials for Future Energy Technologies

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Controlled synthesis of nanomaterials remains one of the grand challenges in materials science. Traditional chemical methods are often complex and offer limited chances to overcome imperfections or aggregation of nanoparticles that lead to reduced performances and stability of nanomaterials in electrochemical applications. Plasma-based synthesis are generally characterized by a higher degree of ionisation and dissociation of reactive species with reduced activation energies for advancement of chemical reactions and transport processes as compared to traditional methods. Plasma processes are also well-suited for upscaling and large volume cost-effective industrial processes.

In this talk, a number of examples will be presented where plasma engineering of nanomaterials is developed to obtain high performance electrodes and electrolytes for energy conversion and storage in fuel cells, electrolysers, solar devices or battery/supercapacitors hybrids. In particular, results on the development of magnetron sputtering processes for synthesis of low-cost Pt-based catalysts for the PEMFC as well as photocatalytic active metal oxide semiconductors for solar hydrogen generation is presented. Furthermore, atmospheric plasma processes in liquids are introduced as novel synthesis routes to produce carbon, metallic or ceramic nanoparticles in suspension with applications in energy storage. Finally, spark-plasma-sintering is discussed as an alternative route to optimize grain boundaries in protonic ceramics for high temperature fuel cells and electrolysers.