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FOCUS ISSUE ON ELECTROCHEMICAL DEPOSITION AS SURFACE CONTROLLED PHENOMENON

Electrochemical Deposition as Surface Controlled Phenomenon: Fundamentals and Applications

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The electrochemical deposition is a complex phenomenon which spans over different areas of chemistry and thermodynamics, mechanics, metallurgy and material science. It takes place at the solid/liquid and/or liquid/liquid interface which makes the process somewhat unique and very attractive. Over the years, our knowledge in this area has significantly improved leading to better definition of the governing phenomena and development of new methods for electrochemical deposition with unprecedented level of morphology control, composition, structure and spatial resolution. We can recognize today examples where electrochemical deposition is used as convenient if not "the only" approach to fabricate complex structures and synthesize materials and catalytic surfaces. The most recent developments suggest that the electrochemical deposition becomes an attractive fabrication and material synthesis approach for many emerging fields of technology with "nano" as a common pre-fix. These new applications make the future electrochemical deposition research a seemingly interesting and quite exciting endeavor.

This focus issue of the *Journal of Electrochemical Society* presents a collection of research papers which discuss the ideas and progress in electrochemical deposition and synthesis of materials in systems where the energetics of the surface and solution species are exploited and manipulated to achieve control over the deposit thickness, nucleation, growth, and microstructure. The electrochemical deposition is examined as phenomenon which is fundamentally a function of surface energetics and chemical activity.

The scientific contributions cover wide range of phenomena. Two contributions are concerned with spontaneous noble metal on noble metal (NMNM) deposition. They are Au/Pt(111) (Ambrozik et al.) and Rh/Au(111) (Strbac et al.) systems which have direct relevance to monolayer catalyst design and fundamental understanding of NMNM deposition process. Deposition via surface limited red-ox replacement of underpotentially deposited monolayer (SLRR) is used as an approach to grow high quality thin films. The systems studied were Cu on Cu and Ru via SLRR of Zn UPD (Venkatraman et al.) and Pd on Au via SLRR of Cu UPD (Jagannathan et al.). In the later case the SLRR deposition is used to modify Pd films with Pt and examine SLRR deposition as method for surface catalytic properties engineering. In the same system, the effects of citrate during the SLRR are studied for synthesis of Pd-Pt core-shell catalyst nanoparticles (Zhu et al.).

Several contributions study the effect of surface and solution energetics and resistivity on deposit composition and morphology. One example is demonstrated using example of electrochemical atomic layer deposition (E-ALD) of alternating layers of p- (CuxZnyS) and n-type (CdS) surface semiconductor compounds. These results have significant potential for synthesis of photovoltaic thin films, p-n junctions and foto-catalyst materials (Berretti et al.). Two more contributions illustrate the effect of substrate bonding and interactions with deposit on nucleation and growth behavior of Cu and Co thin films which are materials of essential importance for electronic and magnetic recording technology (Nagar et al., and Di et al.). Two more examples show the solution energetics and conductivity effects on deposit morphology. The first presents a directed bi-polar deposition as an elegant novel electrochemical metal deposition/patterning technique (Braun et al.), while the second one studies the viscosity effects on Li charge transfer kinetics and deposit morphology evolution (Sano et al.).

Two more papers investigate the electrochemical deposition of alloys. The first one studies phenomenon of underpotential codeposition as an approach for synthesis of Au–Ni alloys with desired properties and composition for catalyst and nanomaterials application (Liang et al.). The second presents the electrodeposition of Co-Cu alloy at particular geometry of the Hull cell as an efficient tactics to obtain sample with spatial variation in Co/Cu ratio and thus a model system to study materials properties over wide range of compositions (Grill et al.).

In conclusion, it has to be said that the researchers in this field have contributed greatly to magnificent development of the technology sector and our society. There is no doubt that this will continue in the future as the quality of papers assembled in this focus issue illustrates high degree of novelty and new ideas. Therefore, I would like to take this opportunity to express my gratitude to all contributors to the focus issue and to share my excitement about the future of electrochemical deposition, the best is yet to come.

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