Department of Chemistry
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המחלקה
לכימיה
הפקולטה למדעים מדויקים
אוניברסיטת בר־אילן

The Department of Chemistry Weekly Seminar

Monday 27/12/21 12:00pm (refreshments 11:45am)

Nanostructured functional materials as electrocatalysts for sustainable resources

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In the quest for improving sustainability of earth's resources that we consume, discovery of new catalysts is a pressing issue. There are several reasons for that, among which are, first, presently the most efficient and stable catalysts for the chemical processes that we use to transform raw re-sources into products with the desired functions (materials or energy type), contain expensive and non-abundant elements such as Pt, Ir, and Ru. This explains the efforts to find abundant, accessi-ble, low-cost, stable alternatives that will yield process efficiencies comparable to those we have today. For example, for water splitting, many new materials with different compositions have shown promising results as catalysts. However, they are mostly prepared by wet chemical synthesis, which results in chemical waste and can be too slow for industrial use. Second, the morphology of the materials is important, because it affects their catalytic properties as higher surface areas yield more catalytic active sites, surface energetics change, leading to improved reaction rates, and other differences that affect catalytic activity. These reasons emphasize the motivation to accelerate the process of finding new materials with varying nanostructures and optimized functionality, by sys-tematic exploration of several parameter spaces.

Glancing angle deposition (GLAD) is a physical vapor deposition (PVD) shadow growth technique where the substrate is positioned at an oblique angle to the vapor source and can be manipulated with regard to substrate tilt angle and rotation, during the deposition. The thin films obtained by GLAD have unique micro- or nano-structures, which depend on ballistic shadowing of the sub-strate, and are formed as nano- or micro-columnar films, leading to 3D nanostructure fabrication.

I will present the first original results I obtained of using GLAD to form different types of material compositions and nanostructures as functional catalysts for sustainable resources. Nano-scale mor-phology and material composition are varied simultaneously using an adapted shadow growth GLAD system, [1] which eliminates the commonly used wet chemical steps for nanostructure synthe-sis. In a well-controlled one-step growth, I quickly and directly attained a large number of different nano-columnar structures, including nanorods, nanohelices, and nano-zigzags, with varying materi-al compositions, on a single substrate. GLAD also serves to form nanoporous ultra-thin mesh structures, in a novel dry synthesis method.[2] Both nanostructure types were studied for their electrocatalytic performance in the O2 evolution as well as CH3OH oxidation reactions and show high activity and stability. The insights I gained, show a dependence of catalytic activity on composition and nanostructuring, which the standard experimental techniques cannot achieve or explore, thus illustrating the importance and impact that GLAD has, and will have, on developing sustainable cata-lysts.

[1] H.-N. Barad, M. Alarcón-Correa, G. Salinas, E. Oren, F. Peter, A. Kuhn, P. Fischer, Mater. To-day 2021, In Press, DOI 10.1016/j.mattod.2021.06.001.

[2] H. Kwon, H.-N. Barad, A. R. S. Olaya, M. Alarcon-Correa, K. Hahn, G. Richter, G. Wittstock, P. Fischer, ArXiv211105608 Phys. 2021.

Location: Seminar room 112

Looking forward to seeing you!