סמינר מחלקתי – הנדסת חומרים

הנכם מוזמנים בזאת לסמינר מחלקתי
אשר יתקיים ביום ה', 4 במרץ 2021 , כ' באדר תשפ"א,
בשעה 14:00, דרך ה-ZOOM

Metal Oxide and Oxynitride Photoelectrodes for Solar Water Splitting

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The widespread application of photoelectrochemical (PEC) water splitting for energy conversion depends on the progress of photoelectrodes that uphold stringent criteria from photoabsorber materials. After investigating almost all possible elemental and binary semiconductor photoabsorbers, the search must be expanded to complex materials. Yet, high structural control of these materials will become more challenging with an increasing number of elements. Complex or multinary metal oxides have applications in many different fields as they offer wide-ranging and highly tunable multi-functionalities, unparalleled among other materials classes, and are considered a class of materials of great potential to discover within such ideal semiconductor photoabsorber. Oxynitrides are a class of materials that further expand and tune the properties of oxides by incorporating an additional anion (i.e., N^{3-}) rather than a cation (M^{x+}). The differences in polarizability, electronegativity, and anion charge can give rise to new and exciting physico-chemical properties of oxides by nitrogen introduction, not only PEC related. However, practical fabrication conditions when using glass-based transparent conductive-substrates with low thermal-stability impedes the use of common synthesis routes of high-quality oxide and oxynitride thin-film photoelectrodes with precise structural control. Nevertheless, rapid radiative heating, a technique that is gaining recognition in the study of emerging photoabsorber materials recently, enables carrying out reactions rapidly at temperatures suitable for the thermodynamic properties of oxides and oxynitrides while maintaining the structural, optical, and electrical integrity of glass-based transparent conductive substrates.
In my talk, I will present new synthesis approaches of oxide and oxynitride photoelectrodes based on physical synthesis techniques such as pulsed laser deposition together with rapid radiative heating, using $CuBi_2O_4$ and TaON, emerging photoabsorbers, as model materials. These approaches enable **a**) high control of synthesis conditions (growth and heating) regardless of the substrate type[1] **b**) exploring multiple growth parameter-spaces of chemical systems, with a high degree of structural-tunability by employing combinatorial approaches.[2]

1. Gottesman, R. et al. Pure $CuBi_2O_4$ Photoelectrodes with Increased Stability by Rapid Thermal Processing of Bi_2O_3/CuO Grown by Pulsed Laser Deposition. *Adv. Funct. Mater*. 28, 1910832 (2020). Impact Factor: 16.836
2. Gottesman, R. et al. Overcoming Phase-purity Challenges in Complex Metal Oxide Photoelectrodes: A Case Study of $CuBi_2O_4$. *Adv. Energy Mater*. 2003474 (2021). Impact Factor: 25.245