MSE 520: SEMINAR SERIES

MATERIALS SCIENCE & ENGINEERING | AUTUMN 2017

NOVEMBER 13, 2017 | 241 MARY GATES HALL | 3:30 PM

Polar Surface Domains on Non-Polar Surfaces and Their Relevance to Photocatalytic Water Splitting

For many years, researchers have sought metal oxide catalysts that efficiently split water in sunlight to produce hydrogen fuel. Polar semiconductors have recently received significant attention because their internal fields separate photogenerated electron-hole pairs and reduce recombination. On surfaces with polar domains, electrons are attracted to positively terminated domains where they promote reduction reactions and holes are attracted to negatively charged domains where they promote oxidation. We have found that polar domains can be created on the surfaces of non-polar materials, including BiVO4, WO3, and SrTiO3. In the cases of WO3 and BiVO4, polarity arises from the flexoelectric effect. On SrTiO3, polarity arises from polar terminations on different terraces. For SrTiO3, it is possible to control the fraction of the surface terminated by positive or negative charges by annealing the surfaces in environments with an excess or deficit of strontium. In this talk, the use of polar domains to control the rate of photochemical reactions will be described.

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Prof. Gregory S. Rohrer is the Head and W.W. Mullins Professor of the department of Materials Science and Engineering at Carnegie Mellon University. He received his Bachelors degree in Physics from Franklin and Marshall College, his Doctoral degree in Materials Science and Engineering from the University of Pennsylvania (where he also conducted post-doctoral research) and joined the faculty at Carnegie Mellon in 1990. Prof. Rohrer's research has the objective of developing structure/property relationships for polycrystalline materials used in structural, electrical, and catalytic applications. He is currently involved in research on crystal growth, surface photochemical reactions, and the relationship between interface properties and the microstructures of ceramics and metals. He has authored or co-authored more than 280 publications, including a textbook on structure and bonding in crystalline materials. Prof. Rohrer is a fellow of the American Ceramic Society and his research has been recognized by a number of awards including the Richard M. Fulrath Award, the Robert B. Sosman Award, and the W. David Kingery Award, all of the American Ceramic Society. In 2011, he served as chair of the University Materials Council. Rohrer is currently a member of the Board of Directors of the American Ceramic Society and is an editor of Acta Materialia.

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