DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering
Winter Seminar Series

3:00 PM, Wednesday, January 11
PISB 104

"Recent Progress on 2D Materials as Catalysts for Hydrogen Evolution and Oxygen Reduction"

Dr. Manish Chhowalla
Department of Material Science and Engineering
Rutgers University

Abstract:
Over the past few years we have shown that chemically exfoliated 2D MoS_2 and WS_2 are excellent catalysts for the hydrogen evolution reaction (HER). Good HER performance in electrolysis is dependent on three steps: (i) charge injection from the cathode; (iii) charge transport to the active site; and (iii) efficient reduction of protons (H^+) at the active sites. It is well known that the edges of MoS_2 nanoclusters are catalytically active. This is because the edges of MoS_2 are metallic and therefore charge injection and transport is facilitated. The edges also contain exposed Mo atoms that are the active sites for HER. Our work has demonstrated that the strained metallic 1T phase of MoS_2 can lower the free energy for the HER limiting reaction so that the basal plane can be made catalytically active. In addition, we have recently demonstrated that the activity of the 2H basal planes of monolayered MoS_2 nanosheets can be made comparable to state-of-the-art catalytic properties of metallic edges and the 1T phase by improving electrical coupling between the substrate and the catalyst so that electron injection from the electrode and transport to the catalyst active site is facilitated. I will summarize the recent developments in 2D materials for HER, including our recent work on using reduced graphene oxide for oxygen reduction reaction, and discuss some challenges.

Bio:
Manish Chhowalla is a Professor, Associate Chair of the Materials Science and Engineering Department, and the Director of the Institute for Advanced Materials, Devices and Nanotechnology at Rutgers University. His current research interests are in the fundamental studies of 2D transition metal dichalcogenides (TMDs). In particular, his group studies the optical and electronic properties of different phases of 2D TMDs. They have demonstrated that it is possible to induce phase transformations in atomically thin materials and utilize phases with disparate properties as electrodes for field effect transistors, catalysis, and energy storage. Prof. Chhowalla has authored over 220 refereed articles, his h-index is 65 and his work has been cited over 25000 time. He held the Jacobs Chair in Applied Physics from 2009 – 2012 at Rutgers University, he is a Fellow of Royal Society of Chemistry and Institute of Physics, and he was awarded the Institute of Physics – Ireland Lectureship in 2013.

Dr. Yury Gogotsi yg36@drexel.edu | 215-895-6446
Keiko Nakazawa knakazawa@coe.drexel.edu | 215-895-2323