PHYSICS COLLOQUIUM

Wednesday, April 16 | 2:00 - 3:00 p.m. | RNS 210

2D Materials and Molecular Interfaces for Energy and Electronics

Carbon based systems such as graphene and polymers have been proposed as successors to silicon and other inorganic semiconductors in a number of applications including solar cells, and microelectronics; however, several persistent chemical issues prevent their wide scale incorporation into real world devices. The first part of this talk will examine one such problem, namely the nature of ultrafast charge localization in organic semiconductors, a problem which plagues organic photovoltaics and organic electronics. Ultrafast angle-resolved photoemission experiments can be used to follow the excited state electron dynamics in these systems. By comparing the electronic dynamics of two model organic chromophores, sexithiophene and its alkylated counterpart dihexyl sexithiophene, it will be shown that the alkyl units are not simple spectator units, but that they efficiently localize charges into small polarons within 250 femtoseconds.

The second part of this talk will focus on recent work adding chemical functionality to graphene. Although graphene is a remarkable material with superlative electronic and thermal properties, its lack of a band gap and its chemical inertness present severe obstacles to its incorporation into the semiconductor industry. I will present recent work investigating the reversible chemistry of graphene with atomic radicals using scanning tunneling microscopy and Raman spectroscopy. Finally, I will talk about new techniques that we are developing in our lab to combine ultrafast spectroscopy with scanning tunneling microscopy.

Cookies and apple cider served!

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James Johns

An associate professor at the University of Minnesota in the department of chemistry, Dr. James Johns earned his Bachelors of Science in chemistry and Bachelor of Arts in physics from the University of Virginia. Dr. Johns earned his Ph.D. in chemistry from the University of California. He has also studied scanning probe microscopy, specifically UHV-STM at Northwestern University. He is currently at the University of Minnesota, where he is working to develop new methods of combining ultrafast spectroscopy with scanning probe microscopy to study the dynamics of charges and excitons at the nanometer scale.