



“Engineering Materials and Functionality at Atomic Level: Toward Next-generation Photonics and Photocatalysts ”

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Abstract: We are interested in exploring the rational design of materials and functionality at the atomic level to develop next-generation photonics and photocatalysts with performance far beyond what can be achieved now. These include extremely flexible optoelectronic circuits with superior computing capabilities, dynamics photonics with fast-switching optical responses, and low-cost high-efficiency photocatalysts for solar water splitting. Our focus is on atomically thin two-dimensional (2D) materials, in particular, transition metal dichalcogenides (TMDC) like MoS₂, WS₂, MoSe₂, and WSe₂ as well as transition metal oxides (TMO) such as NiOOH and MnO₂.

In this talk, I will show our efforts in engineering the composition and structure of 2D TMDC and TMO materials to realize novel photonic and catalytic functionality, and show how we solve some of the major challenges for employing these 2D materials in the development of useful photonic and catalytic devices. These include the development of techniques for the controlled scalable synthesis and perfect transfer of 2D materials, the better understanding of related light-matter interactions and exciton dynamics, as well as the discovery of new catalytic active sites in the materials. The techniques and the fundamental understanding that we have acquired have clearly indicated the promise of 2D materials and paved the way toward our final destination of developing the next-generation photonics and photocatalysts.



Bio: Dr. Linyou Cao has been an assistant professor in Materials Science and Engineering and Physics at North Carolina State University since August 2011. He obtained his PhD degree from the Department of Materials Science and Engineering at Stanford University in 2010, with a thesis on the optical resonances of semiconductor nanowires under the supervision of Prof. Mark Brongersma. Dr. Cao held a Miller Research Fellowship at the University of California Berkeley for one year prior to joining the faculty of NC State, where he worked on quantum dots with Prof. A. Paul Alivisatos. After starting his independent career, Dr. Cao turns to working on 2D materials instead and has published 20+ journal publications with 1400+ citations even since, five of which are selected as ESI Highly Cited Papers. Dr. Cao has won numerous prestigious awards, including NSF CAREER Award, Young Investigator Award from the Army Research Office, and Miller Research Fellowship.

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Location: 233 Mudd