Abstract

Recent “hot topics” in condensed matter physics, ranging from thin film photovoltaics and phase change memory to topological insulators and two-dimensional semiconductors, share one thing in common: they are all based on chalcogenide materials. In this talk, I will discuss our recent research efforts on two classes of such materials: two-dimensional (2D) transition-metal dichalcogenides (TMDCs) and chalcogenide perovskites.

TMDCs have been intensively studied in the past few years. A monolayer TMDC with broken inversion symmetry possesses two degenerate valleys that can be selectively excited by circularly polarized light. The valley degeneracy can be broken by an external magnetic field, leading to valley Zeeman splitting. We demonstrate experimentally that the Valley splitting can be enhanced by more than an order of magnitude, by exploiting the interfacial exchange field from a ferromagnetic substrate. This approach opens up new possibility for valley control for valleytronics applications.

The recent development of organic halide perovskites has led to a revolution in photovoltaics research. The power conversion efficiency of such solar cells has witnessed an unprecedented rate of increase. The progress has inspired us to search for novel semiconductor materials that can inherit the excellent optoelectronic properties of halides, while avoiding their toxicity and instability problems. I will present results on the synthesis and characterization of novel chalcogenide perovskites. These earth abundant, stable inorganic materials with tunable band gap and strong light absorption are promising candidates for solar absorbers and optoelectronic applications.

Short Biography

Hao Zeng received his B.S. degree from Nanjing University and Ph.D. from University of Nebraska-Lincoln, both in physics. He was a postdoc fellow at IBM Thomas J Watson Research Center between 2001 and 2004. At IBM, he worked on magnetic nanocomposites for advanced magnets, and magnetic tunnel junction biosensors. He joined the Physics Department at the University at Buffalo, the State University of New York as an Assistant Professor in 2004. In 2014 he was promoted to full Professor. He is the recipient of an IBM Research Division Award (2003), National Science Foundation CAREER award, UB Exceptional Scholar-Yong Investigator Award and Lixun Young Scientist Award, Chinese Academy of Sciences. He is an editor of Journal of Magnetism and Magnetic materials and an editorial board member of Chinese Physics B. He has published 100+ papers in Journals including Nature, Nature Nanotechnology, Nano Letters, Nano Energy, Journal of the American Chemical Society and Advanced Materials. These papers have been cited for 13,000+ times. Hao Zeng’s research area is in condensed matter and materials physics. His present research interests focus on nanoscale magnetism and spintronics, materials for energy applications and biomagnetics.