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**Probing Electronic Properties of Defects and Boundaries in Low-Dimensional Materials.**

AN-PING LI, Oak Ridge National Laboratory

Electronic properties are the key to the novel applications of low-dimensional materials in electronic and energy technologies. Due to the restricted dimensionality, one distinctive character of these low-D systems is that the electronic properties are critically dependent on the atomic scale heterogeneities introduced by defects and boundaries. Therefore, an important aspect of research is to examine the role of defects and boundaries, particularly the correlation between their structures and electronic properties. Here I will introduce our recent results on the study of defects and boundaries in low-D materials to illustrate how defects and boundaries can largely determine the physical properties by dictating the electron scattering, transport, and excitation processes. This research was conducted at the Center for Nanophase Materials Sciences, which is a DOE Office of Science User Facility.