Advances in creating new functional materials for applications in electronics, sensing, and photovoltaics rely on understanding the relation between material structure and device function. With the tremendous advances in the integrated circuits industry in the past decades, device dimensionality has shrunk into the nanometer scale. Creating innovative devices using novel materials thus requires understanding device structure at these dimensions. Here, Venkataraman and Nuckolls will develop techniques to image the structure of a single-molecule device with atomic precision using a transmission electron microscope. The ability to image these devices will not only allow researchers to “see” what has never been observed before, but, more importantly, will capture the atomic scale structure of the complex nanoscale interfaces between organic molecules and metal electrodes.