北京大学物理学院凝聚态物理与材料物理所

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Molecular Electronic Devices Forming from Carbon Nanomaterials-based Electrodes

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Abstract: In the scenario of device miniaturization motivated by the limits of the inherent quantum effects of conventional silicon-based devices, a recent research is that we have developed reliable and reproducible e-beam lithographic methodologies to covalently wire conjugated molecules into gaps in the range of 1-10 nm on precisely-cut single-walled carbon nanotube or graphene electrodes through amide linkages. These strategies are robust and allow a wide-variety of single molecules or a small collection of molecules to be tested electrically. Based on this, we not only demonstrated a universal platform of how to utilize the diversities of single molecules with special functions and how to install functionalities on molecule-bridged nanojunctions, allowing the conductance of the single-molecule devices sensitive to external stimuli, such as proton, light, ion, and chemical effect, but also demonstrated a powerful tool of carbon nanomaterials as ultrasmall point contacts to realize monolayer and single column transistors, which indicate the interesting chemoresponsive or efficacious light-to-current converting semiconducting properties. These studies apparently provide the deeper understanding of the interplay between molecular structure, assembly, and emergent functions at the molecular level and consequently the novel insights into designing and creating novel molecule-scale optoelectronic devices.

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