Quantum Molecular Machines

Saw Wai Hla

Ohio University and Argonne National Laboratory

Synthetic molecular machines designed to operate on materials surfaces can convert energy into motion and they may be useful to incorporate into solid state devices. The synthetic molecular machines are fascinating and have a great promise to revolutionize scientific and technological fields. This talk will present operation of molecular machines such as molecular motors and molecular linear transport devices operating in the quantum regime on materials surfaces. Fundamental operations of these machines are investigated in an atomically clean environment using low temperature scanning tunneling microscopy, and molecular manipulations on a one-machine-at-a-time basis. These investigations reveal how charge and energy transfer are taken place within single molecule machines and molecular networks. Moreover by introducing dipole active components in the motor arms, communication among the molecular motors can be introduced. Synchronization of the motors can be achieved depending on the symmetry of the molecular assemblies and the strength of the electric field. Furthermore, individual molecular motors can be charged using the inelastic tunneling scheme. This introduces spin-active components in molecular motors and enables us to investigate their spintronic properties. Finally, future prospect of the molecular machine research and their potential applications from medicine to the quantum computation will be discussed.

Use of the Center for Nanoscale Materials, an Office of Science user facility, was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under Contract No. DE-AC02-06CH11357.