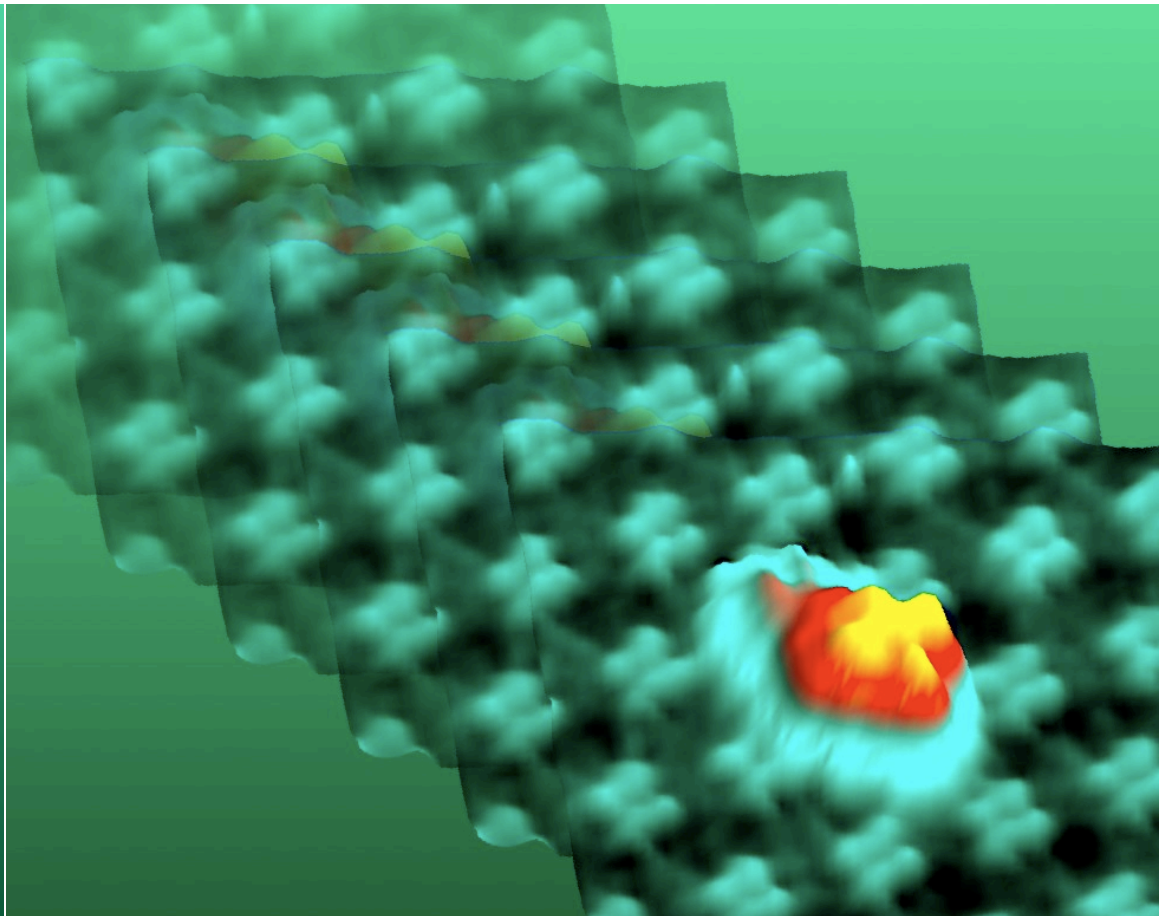
NANOROTOR

Penn State MRSEC



A double-decker molecular rotor pokes out from within an array of single-decker molecules, which isolate the double-decker molecules from each other and thereby give them to room to rotate.

Molecular spin and slide
a double decker rotating sandwich

IRG2

Scaling functional machines down to the molecular scale is a key challenge in nanoscale science and technology. However, coaxing individual molecules into performing well-defined mechanical tasks requires radically different strategies than those used to build familiar macroscopic machines like electrical motors. Toward this end, a team of MRSEC scientists have collaborated with synthetic chemists and physical scientists in Australia, China and Japan to design, assemble, measure, simulate, and optimize molecules that function as nanometer-sized rotors and actuators.

So-called double-decker porphyrin molecules can be isolated within an ordered matrix of single-decker molecules arrayed across a flat substrate. A metal ion connects the lower deck, which acts as a platform, to the upper deck, which is designed to rotate about an axis perpendicular to the substrate. A second class of molecules, the bi-rotaxanes, act as linear actuators when tethered rings move between distinct docking points along a pair of parallel backbones.