Rotation of $(C_{70})_m$-$(Au)_n$ Clusters on Au(111)

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Abstract

Combining metal atoms with fullerene molecules can produce new nano-structures such as $(C_{60})_m$-$(Au)_n$ and $(C_{70})_m$-$(Au)_n$ magic number clusters [1, 2] These clusters have a unique structure consisting of a single atomic layer Au island wrapped by a magic number of C_{60}/C_{70} molecules. The two smallest clusters are $(C_{70})_7$-$(Au)_{19}$ and $(C_{70})_{10}$-$(Au)_{35}$. Using Au(111) as substrate, different sized Au-C_{70} clusters can grow at the bugled or pinched elbow site on the herringbone reconstructed Au(111). These magic number clusters can rotate at room temperature. The rotation seems to be triggered by fluctuation of thermal energy. Between two rotational events, there is a rather long (up to tens of minutes) period of inactivity. We use the scanning tunneling microscope (STM) to monitor the cluster rotation in real time and have conducted experiments to study how the magic number clusters rotate with the change of temperature. We image the magic number clusters using an Omicron VT-STM. We follow each cluster continuously over a period of 48 hours, and are thus able to find the typical time duration between two rotational events.

[1] Y-C. Xie, L. Tang, and Q. Guo. "Cooperative Assembly of Magic Number C_{60}-Au Complexes." *Physical Review Letters* **111,** (2013) 186101.

[2] D. Kaya, D-L. Bao, R.E. Palmer, S-X Du, and Q. Guo, " Tip-triggered Thermal Cascade Manipulation of Magic Number Gold-fullerene Clusters in the Scanning Tunneling Microscope." NANO Lett. **17**, (2017) 6171.