

Microsymposium

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Templated quasicrystalline ordering of single elements and molecules

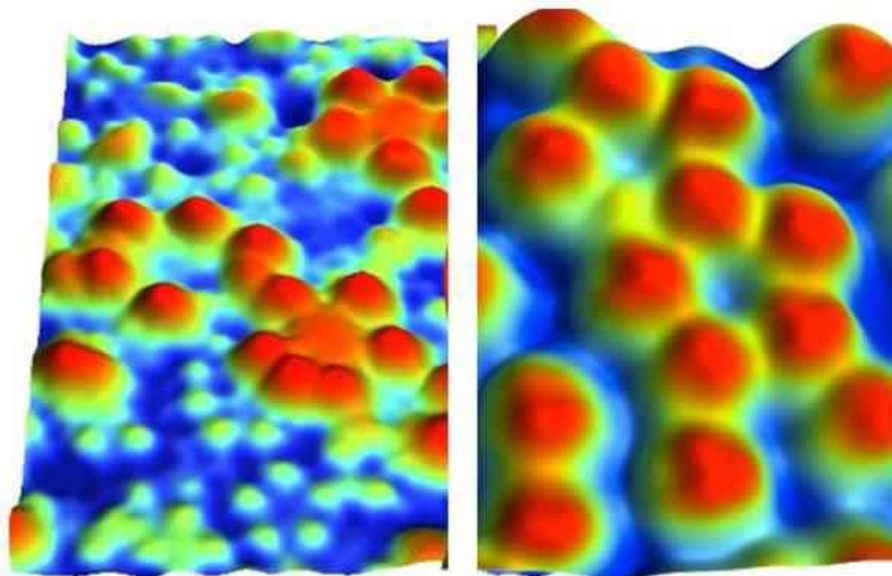
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We have used quasicrystals as templates for the exploration of new epitaxial phenomena. Several interesting results have been observed in the growth on surfaces of the common Al-based quasicrystals [1]. These include pseudomorphic monolayers, quasiperiodically modulated multilayer structures, and fivefold-twinned islands with magic heights influenced by quantum size effects [1]. Here we present our recent works on the growth of various elements and molecules on a new substrate, icosahedral (i) Ag-In-Yb quasicrystal, which have resulted in various epitaxial phenomena not observed previously. The growth of Pb on the five-fold surface of i-Ag-In-Yb yields a film which possesses quasicrystalline ordering in three-dimension [2]. Using scanning tunneling microscopy (STM) and DFT calculations of adsorption energies, we find that lead atoms occupy the positions of atoms in the rhombic triacontahedral (RTH) cluster, the building block of the substrate, and thus grow in layers with different heights and adsorption energies. The adlayer–adlayer interaction is crucial for stabilizing the epitaxial quasicrystalline structure. We will also present the first example of quasicrystalline molecular layers. Pentacene adsorbs at tenfold-symmetric sites of Yb atoms around surface-bisected RTH clusters, yielding quasicrystalline order [3]. Similarly, C-60 growth on the five-fold surface of i-Al-Cu-Fe at elevated temperature produces quasicrystalline layer, where the growth is mediated by Fe atoms on the substrate surface [3]. The finding of quasicrystalline thin films of single elements and molecules opens an avenue for further investigation of the impact of the aperiodic atomic order over periodic order on the physical and chemical properties of materials.

[1] H. R. Sharma, M. Shimoda and A. P. Tsai, *Advances in Physics*, 2007, 56, 403, [2] H. R. Sharma, K. Nozawa, J. A. Smerdon, et al., *Nature Communications*, 2013, 4, 2715, [3] J. A. Smerdon, K. M. Young, M. Lowe, et al., submitted.

Quasicrystalline ordering of Pb (left) and C-60 (right) on fivefold surface of i-Ag-In-Yb



Keywords: Quasicrystal, Surface, Thin film