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Templated quasicrystalline thin film of molecules: recent extended study

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Quasicrystals exhibit long range order without periodicity. Quasicrystalline phases have been observed primarily in intermetallic compounds but also in various other materials such as polymers and oxides. Being different from periodic crystals, intermetallic quasicrystals are promising for the exploration of new epitaxial phenomena. We have reported several interesting epitaxial results when a thin film of single elements or molecules is grown on the surface of quasicrystals. The results include three dimensional quasicrystalline films of single elements such as Pb and Bi [1], quasicrystalline molecular films [2] and fivefold-twinned islands with magic heights influenced by quantum size effects [3]. This presentation focuses on the recent extended study of growth of molecular films by various surface science techniques, including scanning tunneling microscopy (STM).

We have reported that Pentacene molecules deposited on the icosahedral (i) Ag-In-Yb quasicrystal or C60 on i-Al-Cu-Fe produces quasicrystalline order. Pentacene molecules adsorb at tenfold-symmetric sites of Yb atoms around surface-bisected rhombic triacontahedral (RTH) clusters, the building blocks of Ag-In-Yb, and thus yield quasicrystalline order [2]. Similarly, C60 growth is mediated by quasiperiodically distributed Fe atoms on the surface [2]. The compatibility between the characteristic lengths of the substrate and the size of adsorbates has led to a growth of unprecedented epitaxial structures. These observations were limited to the fivefold surface and monolayer films. Recently, we have extended the study at coverage higher than monolayer and also on other substrates, the such as twofold surface of quasicrystals and related periodic crystals. We found that the new results are equally interesting as those reported previously. One such example is the growth of C60 on the twofold surface of Al-Pd-Mn, where the deposited C60 molecules form a Fibonacci grid induced by the substrate structure (see figure below, figure caption: STM observation of Fibonacci grid of C60 formed on the twofold Al-Pd-Mn surface).

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.

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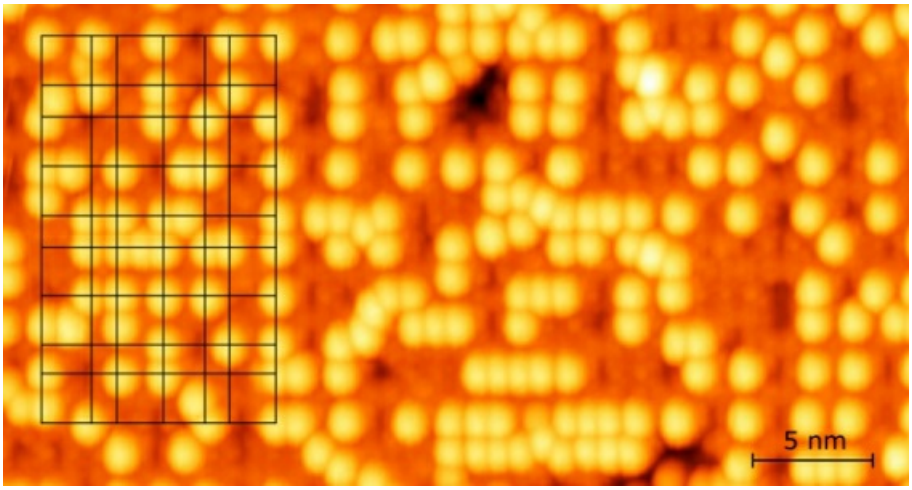

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