Quasicrystalline Thin Films of Single Elements and Molecules

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Quasicrystals exhibit long-range order without periodicity, originally observed in intermetallic compounds. Being different from periodic crystals, quasicrystals show promise for exploring new epitaxial phenomena. In this presentation, I will showcase several interesting epitaxial results when a thin film of single elements or molecules is grown on the surface of quasicrystals and related approximants. The results encompass three-dimensional quasicrystalline films of single elements such as Pb, Bi, and Sb [1,2], as well as quasicrystalline molecular films of C_{60} and Pentacene [3-5].

The icosahedral (i-) Ag-In-Yb quasicrystal, the substrate used in our studies, is constructed by rhombic triacontahedral (RTH) clusters, and its surface is formed on the bulk atomic planes that bisect the RTH clusters. When single elements are deposited on the high-symmetry surfaces, the adatoms adsorb at the sites originally occupied by the cluster atoms, thus producing three-dimensional quasicrystalline films [1]. Pentacene molecules deposited on the surfaces adsorb at tenfold-symmetric sites of Yb atoms around surface-bisected RTH clusters, yielding quasicrystalline order [4,5]. C_{60} molecules preferentially adsorb on Fe or Mn when deposited on surfaces of i-Al-Pd-Mn and i-Al-Cu-Fe [3,5], resulting in quasicrystalline order of C_{60}. The phenomenon of adsorption on selective sites is attributed to electron transfer between the molecules and the substrate atoms. The compatibility between the characteristic lengths of the substrate and the size of adsorbates also plays a role in the growth of unprecedented epitaxial structures. These fabricated epitaxial quasicrystalline structures provide a playground to investigate the influence of quasi-periodicity versus periodicity on the unusual physical properties of quasicrystals.

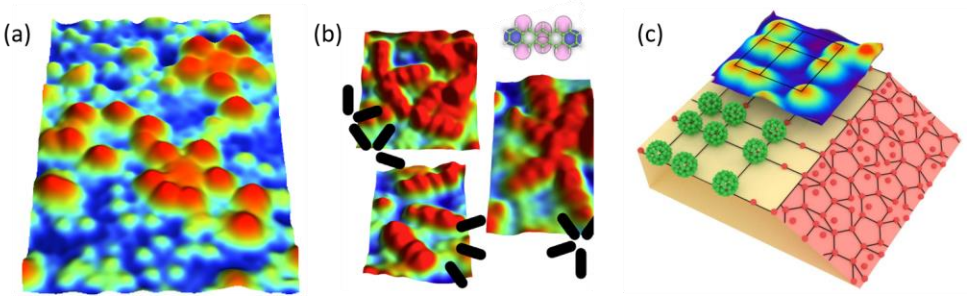

Figure 1. (a) Pb on the fivefold *i*-Ag-In-Yb surface [1], (b) Pentacene on the fivefold *i*-Ag-In-Yb surface [5], and (c) C_{60} on the twofold *i*-Al-Pd-Mn [3].

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