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David Adler Lectureship Award in the Field of Materials Physics Talk: Surfaces of Quasicrystals[1]

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Quasiperiodic order is recognized (in a utilitarian, rather than a mathematical sense) by the absence of periodicity, concurrent with a classically-forbidden rotational symmetry. It is quite beautiful, having captured the attention of scientists and artists alike. Following the discovery of quasiperiodic order in a real system,[2] many metallic alloys and intermetallics were found to exhibit this type of order on the atomic scale. More recently "soft" quasicrystals were discovered,[3] and nanocrystalline arrays were found to spontaneously adopt quasiperiodic order.[4] From a scientific perspective, quasicrystals are alluring because they allow us to test the relationship between atomic structure and physical properties. This talk deals with the ways in which our understanding of solid surfaces has been both enriched and challenged by these complex materials.[5,6] properties of the metallic quasicrystals originally generated interest because they were unusual.[7] For instance, among Al-rich alloys, the Al-based quasicrystalline phases exhibit puzzling resistance to surface oxidation. Also, Al-rich quasicrystals have surprisingly good and promising catalytic properties (e.g. for steam reforming of methanol).[8] Perhaps most famously, they exhibit low friction.[7] Comparisons with crystalline materials have established that these features are deeply related to the quasiperiodic atomic structure. talk focuses, first, on the ways that surfaces of quasicrystals are unusual templates for adsorption and solid film growth.[9] They can enforce quasicrystalline structure in films,[10] opening the door to exploration of the properties of materials in such an "unnatural" state. The electronic structure at quasicrystal surfaces can affect film morphology through a quantum size effect.[11,12] Quasicrystal surfaces have broad ensembles of adsorption sites,[13] including trap sites that may lead to quasi-periodic arrays of islands.[14,15] This talk also focuses on their low friction, when measured with techniques that probe macroscopic scales (conventional pin-on-disk tribometers) to nanoscopic scales (atomic force microscopy).[16]

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