Fabricating novel Symmetry Nanoscale Systems using Quasicrystal Surfaces

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Quasicrystals are metallic alloys which have unusual structural properties: they are aperiodic and may display symmetries not observed in periodic materials. The surfaces of these materials offer opportunities for the fabrication of nanostructures and thin films which themselves have unusual symmetries and structures. In turn, measurements of such nanostructured systems may offer insights into the larger question of the relationship between physical properties and aperiodicity. Several such systems have been fabricated and are under investigation in our laboratory, and some examples will be shown.

One spectacular case is that of an ultrathin film grown by the deposition of copper atoms on the five-fold surface of the icosahedral $Al_{70}Pd_{21}Mn_9$ quasicrystal [1]. STM images show that the in-plane structure comprises rows having separations of S=4.5±0.2 Å and L=7.3±0.3 Å, whose ratio is the Golden mean τ=1.618... within experimental error. The sequences of such row separations form segments of terms of the Fibonacci sequence, indicative of the formation of a pseudomorphic Cu film. We have recently demonstrated that such films can also be grown using magnetic elements such as Co, Fe and Ni. Characterisation of their magnetic properties has also been undertaken and will be discussed.

[1] Ledieu J., Hoeft J.T., Reid D.E., Smerdon J.A., Diehl R.D., Lograsso T.A., Ross A.R., McGrath R., *Phys. Rev. Lett.,* 2004, **92**, 135507.

Keywords: quasicrystals, nanostructures, scanning tunnelling microscopy