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"Surfaces of complex intermetallics: Quasicrystals, Heusler's, high-entropy alloys"

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Quasiperiodic structures exhibit long-range order like normal crystals but lack translational symmetry. Quasicrystals were first discovered as a new class of intermetallic compounds [1], now comprising hundreds of members in binary and ternary systems. They usually adopt either the icosahedral or the decagonal point group symmetry. Latter, quasicrystals were also found in soft matter systems [2], in two-dimensional oxide thin films grown on periodic substrates [3,4], and even in meteorites [5] !

The discovery of quasicrystals has led to a paradigm shift in crystallography and has attracted a large interest in the material science community, motivated by unexpected physical properties that could be linked to quasiperiodicity. This remarkable class of materials has also challenged our understanding of metal surfaces. An atomic scale description of their surfaces is especially important, as it forms the basis for understanding and predicting phenomena such as gas adsorption, metal epitaxy, and friction. Here we will review some key results on the characteristics of their surface structure, their physico-chemical properties and how these surfaces can be used as templates to grow artificial quasiperiodic systems. We will also briefly present some recent ongoing research on the surface of different class of complex intermetallics, namely Heusler ferromagnetic shape memory compounds and high-entropy alloy thin films.

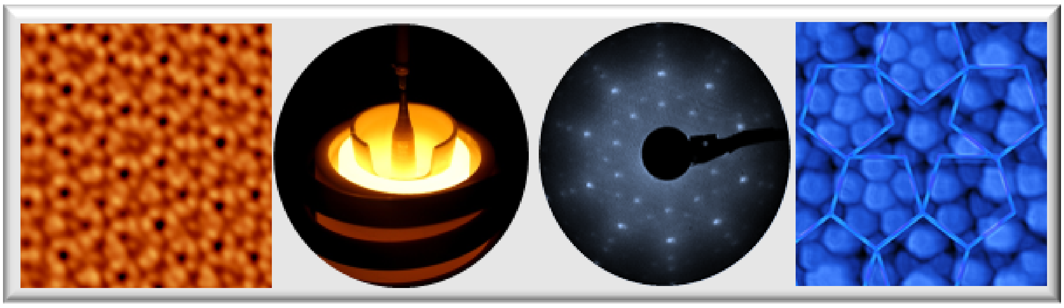

Figure: From left to right: STM image (10x10nm2) of the clean 5-fold Ag-In-Yb quasicrystalline surface (10x10nm2) ; Czochralski growth of a single grain quasicrystal ; Low-energy electron diffraction pattern of a 10-fold Al-Ni-Co decagonal quasicrystal ; STM image (8x8nm2) of a decagonal quasiperiodic C60 film.

[1] D. Shechtman, I. Blech, D. Gratias, J. Cahn, Phys. Rev. Lett. 53, 1951–1953 (1984).
[2] C.R. Iacovella, A. S. Keys, S. C. Glotzer, PNAS 108, 20935 (2021).
[3] S. Förster, K. Meinel, R. Hammer, M. Trautmann, W. Widdra, Nature, 502, 215 (2013).
[4] C. Ruano, T. Dorini, F. Brix, L. Pasquier, M. Jullien, D. Pierre, S. Andrieu, K. Dumesnil, S.S. Parapari, S. Šturm, J. Ledieu, M. Sicot, O. Copie, E. Gaudry, V. Fournée, Phys. Chem. Chem. Phys., 24, 7253 (2022).
[5] L. Bindi, P. J. Steinhardt, N. Yao, P. J. Lu, Science 324 1306 (2009).