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Pentagonal gold bipyramids self-assemble with long-range triclinic order

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ABSTRACT:

The packing of solid bodies is one of the oldest problems in the natural sciences. Among the various shapes, spindles (elongated objects with two sharp tips) yield a surprising variety of arrangements, depending on their cross-section. We elucidate for the first time the three-dimensional stacking of spindle-shaped objects, experimentally and via simulations, by focusing on bipyramids of regular polygonal base with *n* sides. For *n* = 5 the crystal symmetry is triclinic, with lower symmetry than the building blocks of the structure and with two particles per unit cell. Further simulations confirm that these features are present for other odd *n* values: they can be attributed to the non-centrosymmetric shape of the particles. Surprisingly, this symmetry reduction is accompanied by a lower packing fraction than in the even *n* case [1].

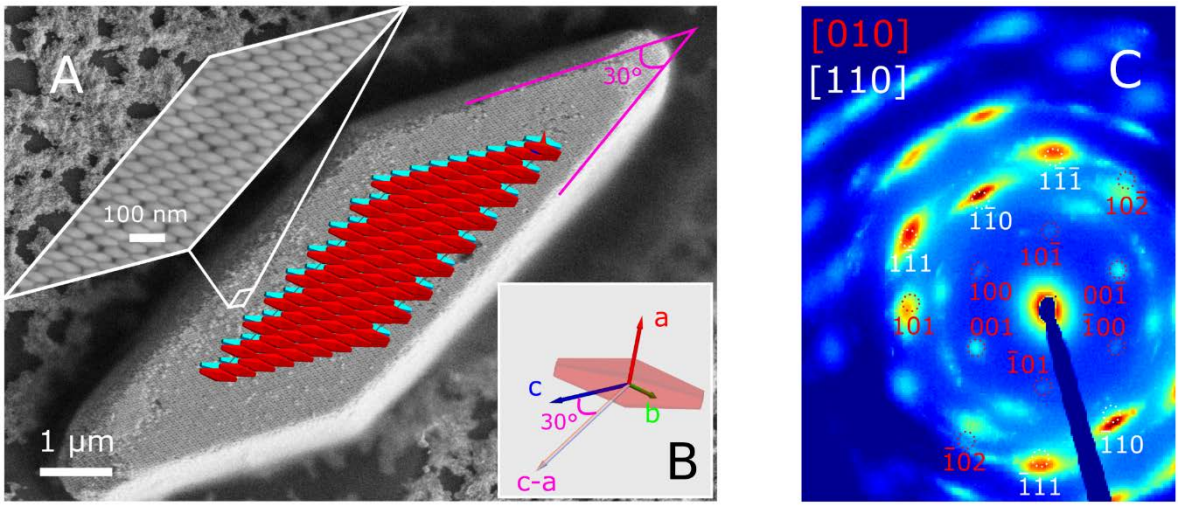

Figure 1: A) SEM image of one supercrystal, with superimposed model (the unit cell contains one red and one blue particle, rotated by 2π/5 with respect to each other). Inset: magnified image of the supercrystal surface. B) Unit cell of the model oriented along the c and c-a vectors of the triclinic lattice. C) 2D SAXS image (in log intensity scale). The Miller indices corresponding to the triclinic lattice are indicated on some Bragg spots. Two colors (red and white) are used for the indexation of two supercrystals with different orientation defined by the corresponding zone axis [UVW].

References

1- J. Lyu, W. Chaabani, E. Modin, A. Chuvilin, T. Bizien, F. Smallenburg, M.Impéror-Clerc, D. Constantin and C. Hamon, submitted.