

MS23-2-5 A tale of two closely related 1/1 Tsai-type quasicrystal approximants in the RE–Au–M (RE = rare-earth elements, M = p-block elements) systems

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Abstract

In this work, we review our current understanding of atomic structures, formation conditions, compositions, and temperatures for Tsai and pseudo-Tsai phases 1/1 ACs in the RE–Au–M (RE = rare-earth elements, M = p-block elements) systems. The atomic structures of the 1/1 ACs have been determined from single-crystal X-ray diffraction data and described using concentric atomic clusters with icosahedral symmetry. We hypothesize the presence of pseudo-Tsai phases is a more common phenomenon that occurs in more systems^{1,2}. The pseudo-Tsai phases are structurally similar yet physically different from the Tsai phases^{3–5}. Tsai-type phases are distinguished by a cluster unit made up of five concentric polyhedral shells: the disordered tetrahedron, a pentagonal dodecahedron, an icosahedron, an icosidodecahedron, and an outer-most triacontahedron. The Tsai phase contains disordered tetrahedron decorated with Au/M mixed sites, Pseudo Tsai phase contains a RE site at the centre. Both cluster types can be found coexisting in the approximants. The structural differentiations between Tsai and pseudo-Tsai phases exhibit strong correlations between lattice parameters, cluster sizes, particular site occupancies, and valence electron counts.

References

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