

## Unusual interfacial structures and evolution of metastable precipitate phases in aluminium alloys

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Solid-state precipitation is an important phenomenon in the development of many natural and synthetic materials such as artificial bone, alloys used in the fuselage of aircraft and rocks in the Earth's interior. The precipitates thus formed are often metastable phases occurring in far-from-equilibrium conditions. Their nucleation and growth mechanisms remain poorly understood, mainly because characterising the interfacial structures, and sometimes even the bulk structure of such precipitates embedded in a crystalline matrix, is very challenging.

Precipitation-hardened aluminium alloys constitute excellent model systems for the investigation of the fundamental processes of solid-state nucleation and growth. These alloys also have great practical importance due to their lightweight – high-strength characteristics.

We will present recent work on the characterisation of matrix-precipitate interfaces in simple binary and ternary aluminium alloys, using atomic-scale scanning transmission electron microscopy imaging and density functional theory calculations. We will show the existence of unusual interfacial structures that cannot be easily predicted based on current understanding. These structures allow a rationalisation of observed behaviours of interfacial segregation. They also suggest atomic-scale models for the mechanisms of growth, and potentially, nucleation, of solid-state precipitates in aluminium. We will discuss the possible broader implications of these results on the study of nucleation processes in general.