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Formation of monodisperse $Al_3(Sc,Li)$ ordered precipitates in an Al-rich matrix

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We have been able to grow monodisperse $Al_3(Sc,Li)$ core/shell ordered precipitates in an Al-rich matrix by solid-state reaction using a three-stage heat treatment that exploits differential diffusivities and solubilities of Li and Sc in Al [1]. The atomic structure of these precipitates has been studied by a range of advanced microscopy and spectroscopy techniques combined with first-principles calculations of bonding between Sc and Li within the $L1_2$ ordered structure. The enhanced chemical sensitivity of TEAM 0.5, a double-C_S-corrected microscope, was employed to image Li using exit wave reconstruction. The conventional high-resolution image in Figure 1a reveals the fully ordered structure of the shell. The field-ion microscopy (FIM) image in Figure 1b indicates that Sc is confined to the core while Li is primarily located in the shell. The phase of the exit wave shown in Figure 2a reveals long-range order of the Li-rich shell, in which Al columns (red) can be clearly distinguished from Li columns (blue), as shown in Figure 2b. A detailed analysis of the structure and composition of these precipitates has provided important insights into their mechanism of formation and resistance to coarsening [2].

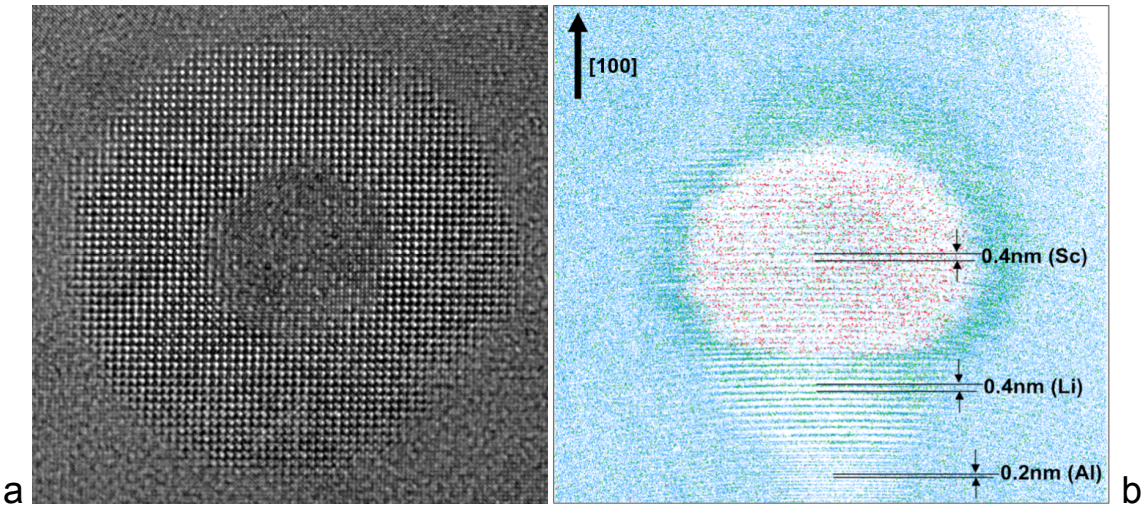

Figure 1: (a) High resolution TEM and (b) atomic resolution FIM images of $Al_3(SC,Li)$ ordered precipitate.

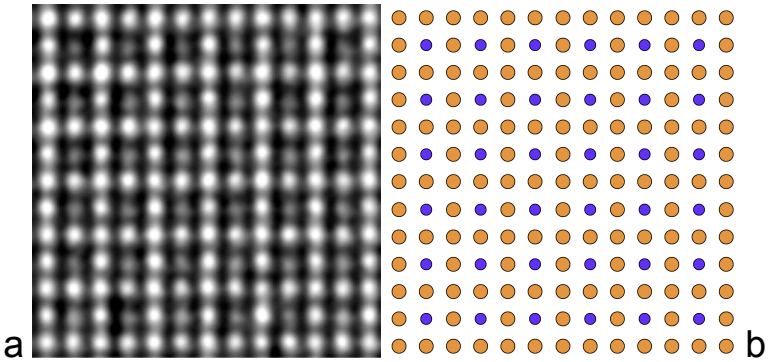

Figure 2: (a) Exit wave phase image in the [001] zone axis orientation of the Al_3Li shell (6x6 unit cells) showing visibility of Li; (b) Corresponding model of $L1_2$ fully ordered Al_3Li (6x6 unit cells; Li columns shown in blue and Al in red).

References

[1] V. Radmilovic et al., Scripta Materialia, **58** (2008) 529.

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