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Quantitative three-dimensional imaging of chemical short-range order via machine learning enhanced atom probe tomography

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Chemical short-range order (CSRO), referring to specific elements self-organising within a disordered matrix, can modify the properties of materials. CSRO is typically characterized via two-dimensional microscopy techniques that fail to capture three-dimensional atomistic architectures. Here, we present a machine-learning enhanced approach to reveal three-dimensional imaging of CSRO in body-centred-cubic Fe-18Al alloys. After validating our method against artificial data, we unearth non-statistical B2-CSRO instead of the generally-expected D03-CSRO. We propose quantitative correlations among annealing temperature, CSRO, and the nano-hardness and electrical resistivity. The proposed strategy can be generally employed to investigate short/medium/long-range ordering phenomena in a vast array of materials.

Poster title

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