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Mechanical Microscopy Using Correlative Nanoindentation and Analytical Electron Microscopy

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Mechanical microscopy is an emerging technique using high-speed nanoindentation to map the mechanical behaviour and extract phase-level properties from complex microstructures with sub-micron-scale lateral resolution. As such, it is a powerful technique for phase identification in combinatorial materials science investigations on samples with compositional gradients, such as diffusion couples [1] – Figure 1.

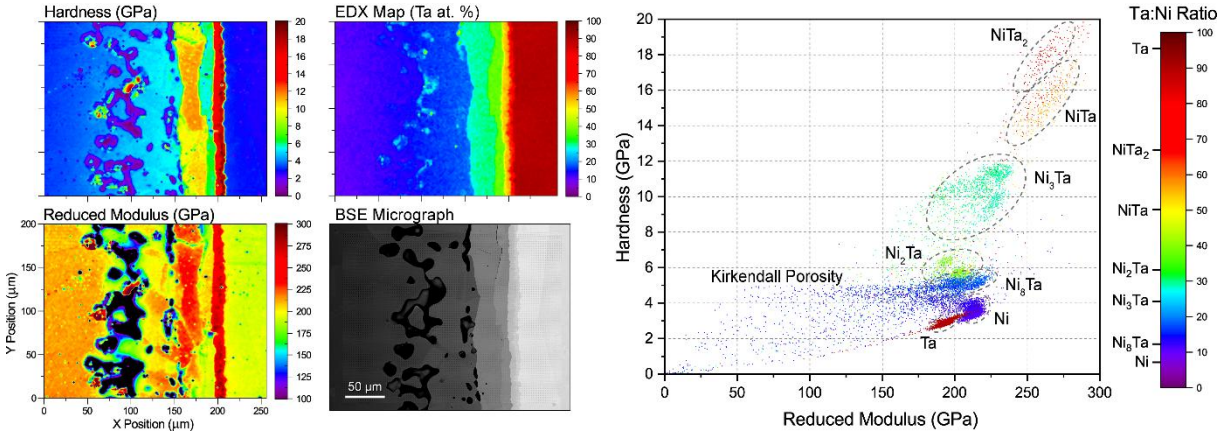

Fig.1 Correlated property and composition maps from indentation and electron microscopy, and a composition-labelled scatter plot of indentation properties.

A significant challenge for nanoindentation mapping is the statistical separation of phases with adjacent compositions and mechanical properties [2]. In this work, we address this by using correlative mapping with analytical electron microscopy, particularly EDX and EBSD, to accurately determine the relationships between mechanical properties, composition, and crystallographic orientation within various microstructures.

References:

[1] J.M. Wheeler, B. Gan & R. Spolenak, “Combinatorial investigation of the Ni—Ta system via correlated high-speed nanoindentation and EDX mapping,” Small Methods (2021). (https://doi.org/10.1002/smtd.202101084)

[2] H. Besharatloo, J.M. Wheeler, “Influence of indentation size and spacing on statistical phase analysis via high speed nanoindentation mapping of metal alloys,” Journal of Materials Research 36 (2021) 2198–2212.