Techniques for performing simultaneous in-situ Transmission Kikuchi Diffraction (TKD) and Digital Image Correlation (DIC)

Bhatia, V.[1], Sneddon, G.[1] and Cairney, J.[1]

[1] Australian Centre for Microscopy & Microanalysis, University of Sydney, Australia

Digital Image Correlation (DIC) is a powerful technique to track local strain distributions that occurs in materials under deformation. More recently this technique has been applied to SEM (SEM-DIC) providing high resolution strain maps of micro tensile samples [1]. This is achieved by producing a speckled pattern on the surface of the material and tracking the relative changes through the captured images. Another useful technique that can be applied to in-situ deformation is Electron Backscatter Diffraction (EBSD). By collecting Kikuchi patterns at different loads, it is possible to observe the crystallographic changes that occur in the sample such as the texture of grains, phase transformations and, in some cases, elastic strain measurement [2]. Until now these in-situ techniques have typically been performed on bulk samples, however the progression in this field has seen a demand to study nano-structured materials at higher resolutions, so as to better understand the deformation mechanisms that occur. In this work we have shown that it is possible to perform TKD or t-EBSD in-situ while simultaneously acquiring nanometre resolution DIC images using the SEM on nano-tensile samples. We discuss the sample preparation methods for this technique including the challenges of creating a speckled pattern for DIC measurement. We will also compare the advantages and limitations of collecting these high-resolution data sets and how the simultaneous acquisition of TKD and DIC can be applied to better understand the deformation mechanisms.

1. Kammers, A.D. and S. Daly, *Digital image correlation under scanning electron microscopy: methodology and validation.* Experimental Mechanics, 2013. **53**(9): p. 1743-1761.
2. Wilkinson, A.J. and T.B. Britton, *Strains, planes, and EBSD in materials science.* Materials Today, 2012. **15**(9): p. 366-376.