Cross-correlation-based Analysis of EBSD patterns:
Mapping Strains, Curvature and GND Distributions

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The use of cross-correlation functions to measure small shifts in EBSD patterns allows the variation of elastic strain and lattice rotation to be studied in the 'humble' SEM at a sensitivity of ~10^{-4}, and at high spatial resolution. The technique is thus competitive with synchrotron-based methods, but with the advantage of being available in your lab, rather than a centralised facility. Currently patterns are obtained at a resolution of ~1k by 1k by 12 bit deep and recorded to disk for off-line batch-wise analysis. Exposure times typically range from a few tenths of a second to a few seconds depending on application.

The basis of the technique will be described, along with experiments validating the sensitivity. Use of the method will be illustrated through applications to (i) elastic and plastic relaxation of SiGe/Si semiconductor heterostructures, (ii) thermal and mechanically driven deformation near hard inclusion in a superalloy, and (iii) GND accumulation in polycrystalline Ti alloys following tensile and cyclic deformation.