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EBSD Analysis of Strain

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Electron Backscatter Diffraction (EBSD) systems have become commonplace in microscopy facilities within materials science and geology research laboratories around the world. This is largely due to the capability of EBSD to aid the research scientist in understanding the crystallographic aspects of microstructures. A survey of the literature shows that EBSD has been used for a wide variety of materials and applications. One area of application is in quantifying strain at the sub-micron scale. Unfortunately, there is a considerable amount of confusion as to what is practically possible to achieve in characterizing strain using EBSD. For instance, it is important to distinguish between elastic and plastic strain. Elastic strain and plastic strain manifest themselves very differently in EBSD results. For example, figure 1, shows a cartoon sketch of the effect of dislocations on an EBSD pattern.

We will review what is practically possible given the current state of technology in terms of strain analysis. First, we will consider the effects of both elastic and platic strain on the EBSD patterns. Second, the use of EBSD maps for characterizing strain will be explored. Both the potential of the technique and its limitations will be discussed. The sensitivity of various calculation and mapping parameters on the EBSD based characterizations of strain will also be presented. A couple of examples are shown in figure 2.

In addition, advanced techniques for quantifying strain will be presented.

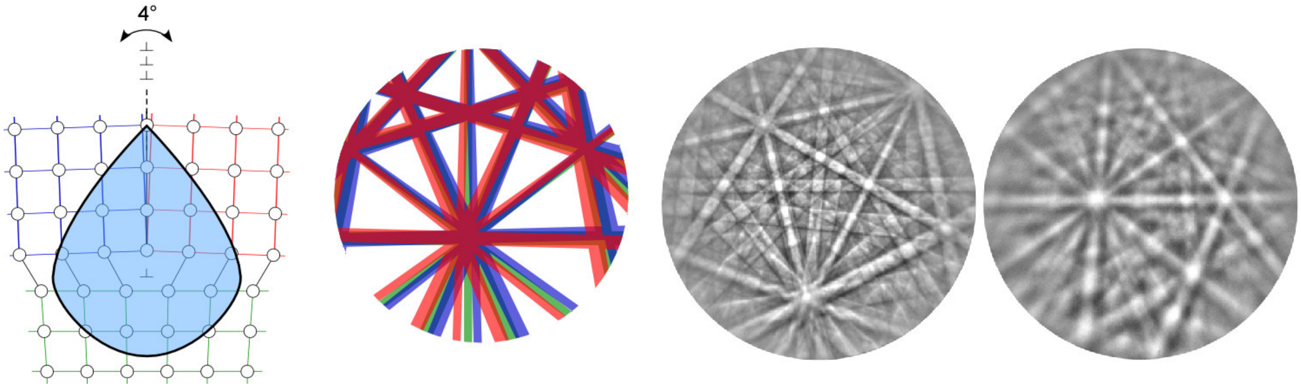

FIG. 1. Schematic of the effect of subgrain boundaries on an EBSD pattern – the pattern is essential a composite of the patterns from all three subgrains. EBSD patterns from a strain free region and a strained region in zirconium are also included.

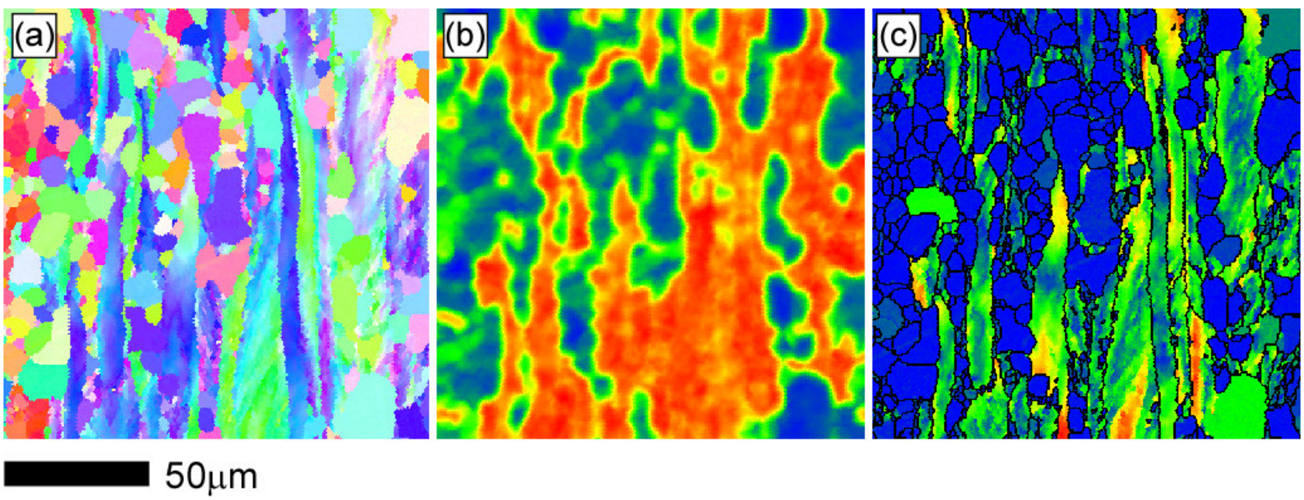

FIG. 2. Local variations in orientation are an indicator of dislocation density in polycrystalline materials. Several different types of maps for highlighting these local variations in orientation can be used. Map (a) is an orientation map showing which plane in the material is aligned with the sample normal. Map (b) shows the variation of orientation within a small window at each point in the scan area. Map (c) shows the variation in orientation in each grain relative to the average orientation of the grain.

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