Electron Microscope Characterization Over a Wide Range of Length Scales of the Microstructure in Metals Deformed to Large Plastic Strains

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The talk will discuss how a combination of SEM and TEM-based techniques can be used to characterize the deformation microstructure of samples deformed to large strains over a wide range of length scales. On the sample and meso-scale SEM-based orientation measurements can be used to assess to the homogeneity (or more usually the heterogeneity) in the refinement by high angle boundaries. In the TEM orientation measurements can be made in crystallites with a linear dimension of down to $\approx 10$nm using a nano-beam diffraction technique. Such measurements are illustrated by an analysis of the microstructure evolution during drawing of pearlitic steel wires to a true strain of 3.7. It is shown that large orientation differences can develop between neighbouring ferrite laths, which has certain implications or the question of cementite dissolution during deformation. A significant dislocation density is also found within the ferrite laths, with subdivision by low angle boundaries also observed in some laths. An outstanding question is the nature of the deformation process within the Fe3C, which is shown to deform plastically during the drawing process, accompanied by process of crystallite subdivision.