Using orientation microscopy to explore the correlation of materials properties and microstructures

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Understanding the correlation between the microstructure of a material and its corresponding properties is one of the important goals of materials science. A good understanding of this relationship allows tailoring microstructures in order to obtain desired properties. This is the basis of microstructure engineering.

Orientation contrast microscopy based on electron backscatter diffraction (EBSD) in the scanning electron microscope is perhaps the most powerful tool to observe and quantify microstructures on a broad length scale and in 2 and 3 dimensions. It enables to quantify dislocation densities, phase composition, grain- and phase boundary networks, textures and even residual stress distributions. It is, therefore, the method of choice for microstructure engineering.

In this contribution we will show examples on how quantitative microstructure data can be obtained using EBSD-based orientation microscopy and related techniques and how this information is employed to determine and interpret mechanical and other properties of materials: by example of DP steels we show how to understand strength and toughness and how to optimize these properties. An example on CdTe solar cells illustrates how to use the knowledge on boundaries and their optoelectronic properties to optimize solar cell efficiency.