Analysis of the microstructure of cemented carbide materials

Background

Cemented carbides are composite materials consisting of a hard WC skeleton embedded in a Co based binder phase, see figure 1. The combination of high hardness, high toughness as well as good wear resistance makes cemented carbide an excellent choice for rock drilling as well as different metal cutting applications. Smaller additions, such as of chromium, have an advantageous effect on the performance of the material, and it is of major interest to understand the underlying reason for this.

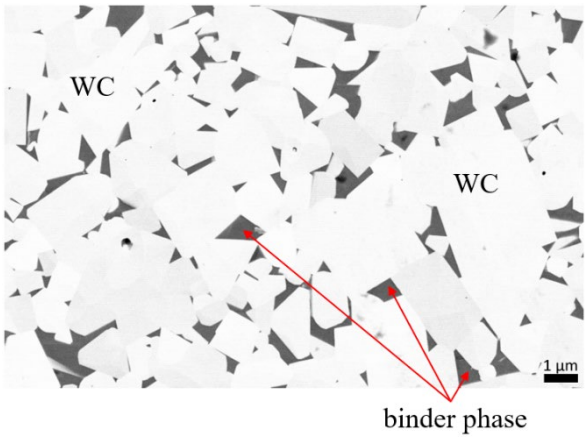

Figure 1: Scanning electron microcopy micrograph showing the microstructure of cemented carbide.

Atom probe tomography is an experimental technique in which atoms are analyzed one by one from a needle shaped specimen. The analysis can be used to make a three-dimensional reconstruction of the material, see figure 2. With atom probe tomography it has been shown that chromium segregates to WC/Co phase boundaries, which effects WC grain growth, and potentially also the resistance to plastic deformation during usage.

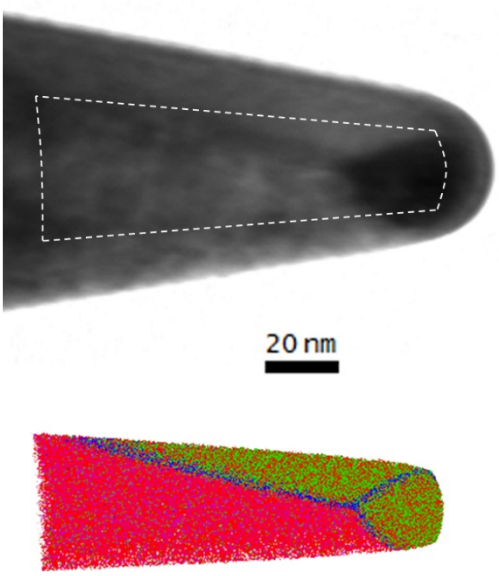

Figure 2: Transmission electron microscopy image of a needle shaped cemented carbide specimen together with a corresponding atom reconstruction from atom probe tomography.

Project description

In this experimental project you will use atom probe tomography to analyze atomic layers in WC/Co phase boundaries of cemented carbide materials that have been used in a controlled environment in terms of temperature and load. The project is carried out at Chalmers in collaboration with Sandvik.

Number of students: 1

Target group: Engineering physics students

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