Access to large area cross sections with FIB for the characterization of the SiC/diamond interface

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The use of coatings becomes more and more important for the realization of complex functional or wear behavior. For example, many cutting tools or other wear parts are ennobled with complex carbides, carbonitrides or oxide coatings [1, 2]. Recently CVD-diamond coated silicon carbide seals were developed. Compared to others, these ceramic seals show a strong increase in lifetime under temporary dry-running conditions and mixed lubrication as well as in abrasive media [3].

For the understanding of coating adhesion and lifetime of coated components, it is necessary to investigate the interface between the substrate and the coating in detail. Defects, e.g. cracks, in the coating, at the interface or in the substrate can be critical for the adhesion and the wear behavior of coatings. For a reliable characterization of workpiece coatings a large interface region has to be investigated. This is necessary because even rare defects may determine their properties.

Different methods are common for interface preparation: mechanical preparation, Broad Ion Beam (BIB) cutting and Focused Ion Beam (FIB). Mechanical preparation of samples containing thin layers is often critical because damages at the interface cannot be excluded. Contrary to this it is possible to prepare cross section surfaces nearly free of artefacts with FIB. However, the accessible area is small (< 100µm x 50µm). With the BIB technique it is possible to access larger areas, typically 3mm x 0.5mm [4]. After BIB preparation no chipping off of layers and no rounding effects at the surface are observed. BIB cross sections can be directly investigated with SEM for many applications [4]. However, due to redeposits and not perfectly flat cross section surfaces a detailed study of the microstructure is not possible (see Fig. 1). In such cases a combination of BIB and FIB technique allows both, a statistical relevant analysis of an interface area which is large enough and a detailed analysis of local defects. In this work the possibilities of the combined BIB and FIB method will be demonstrated by investigation of the SiC/diamond interface.

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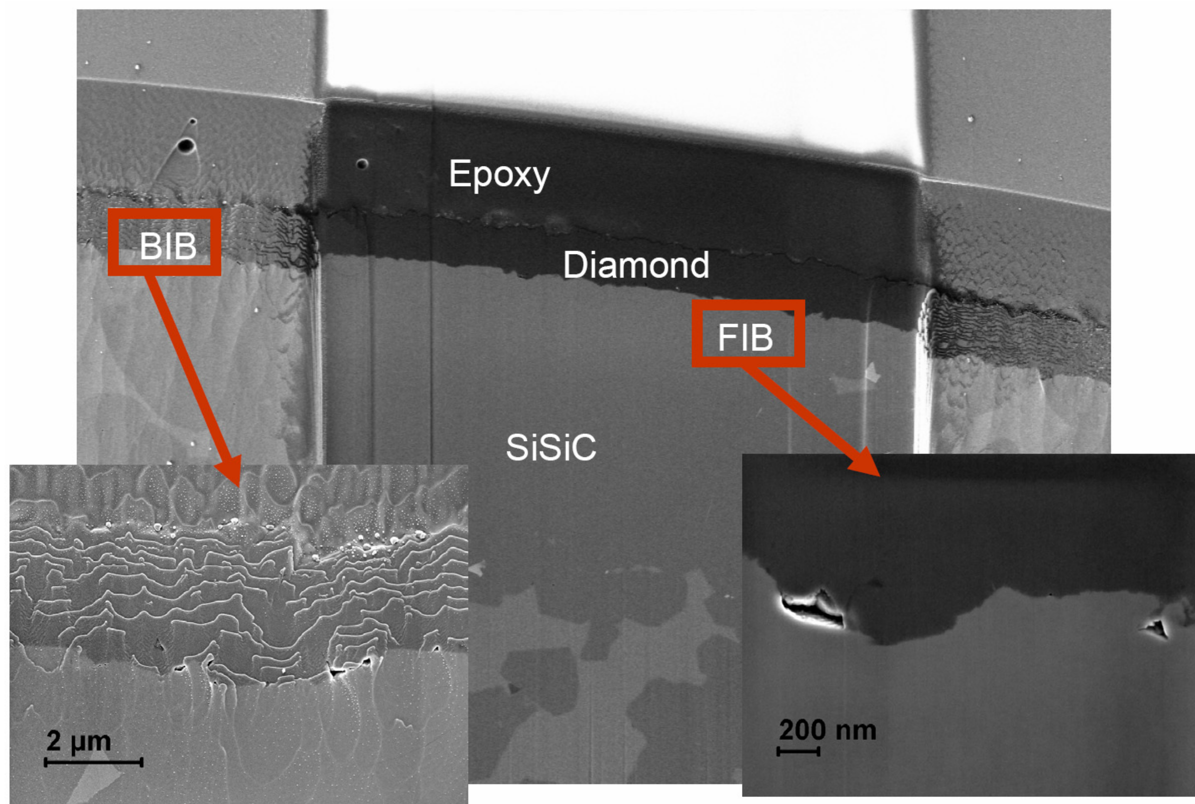

Figure 1. FESEM image after BIB and FIB preparation of the SiC/diamond interface of a SiSiC sample. Left inset: BIB prepared area. Pores are present at the SiC/diamond interface. Right inset: FIB polished region. The shape of the pores can be studied precisely.

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