Slope cutting with a broad Ar ion beam for SEM investigations – studies of artefacts on porous, inhomogeneous and temperature-sensitive materials

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In order to avoid typical artefacts of classical preparation methods, like smearing and scratches during mechanical grinding and polishing, (cross) section preparations for scanning electron microscopy (SEM) are more frequently done with ion beams [1]. Good results are reached with an Ar ion beam; due to the low mass of Ar ions (compared to the mass of Gaions in the focused ion beam FIB), the sample is hardly damaged during the interaction between ions and matter. When cutting with Ar ions, the ion beam is conducted along a screen to the sample, where material removal (sputtering) leads to a cross section in the screen plane (Fig 1). This surface shows good material and channeling contrasts on dense and homogeneous materials (Fig. 2). Electron backscattered diffraction (EBSD) as well as cathodoluminescence (CL) measurements are possible. Preparations with Ar ions are possible on layered systems, on powders and fibers as well as on rough surfaces. For porous and multiphase systems with large differences in hardness, artefacts can occur, primarily curtaining (Fig. 3) and redeposition (Fig. 4). Additionally, temperatures can increase above 100 °C, which can damage temperaturesensitive samples during the cutting process. The SEM investigations were made at the Fraunhofer Institute for Silicate Research with a commercial available equipment (Cross Section Polisher SM09010 from JEOL) [2].

1. Wolfgang Hauffe: Broad Ion Beam (BIB) slope cutting trough Sncoated copper wires for 3D Scanning Electron Microscopy and Microanalysis. Microsc Microanal 13(Suppl 2), 2007
2. Masateru Shibata: Cross section specimen preparation device using Argon ion beam for SEM – Cross Section Polisher (CSP) SM09010. JEOL News, Vol. 39, No. 1, 2004

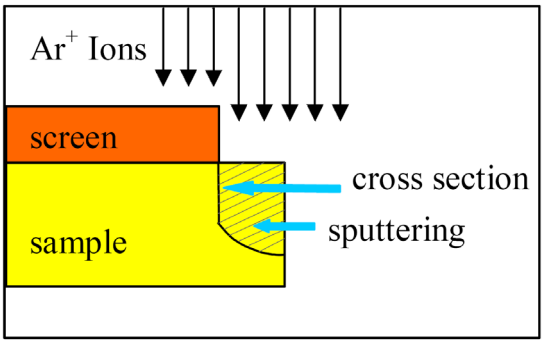

Figure 1. Principle of the Cross Section Preparation with an Ar ion beam. The Ar beam is led to the sample along a screen, forming a plane surface by means of material removal (sputtering).

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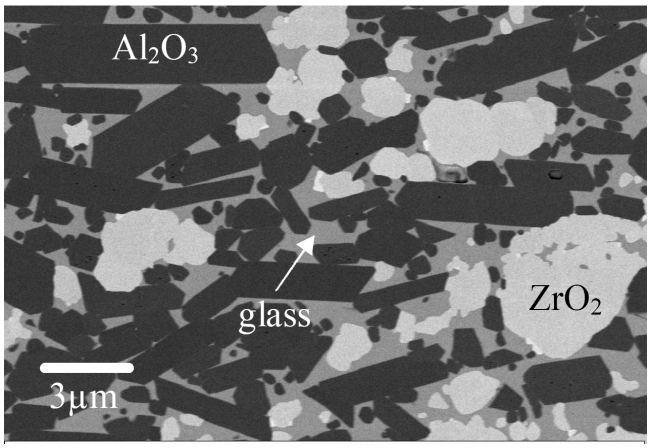

Figure 2. Glass ceramics exemplify an almost artefactfree preparation by Ar ion beams on dense, homogeneous materials.

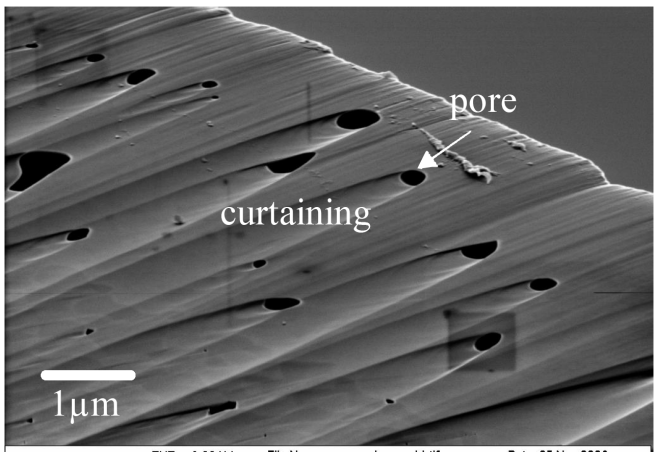

Figure 3. The Ar ion beam is deviated inwards at pores, which causes curtaining.

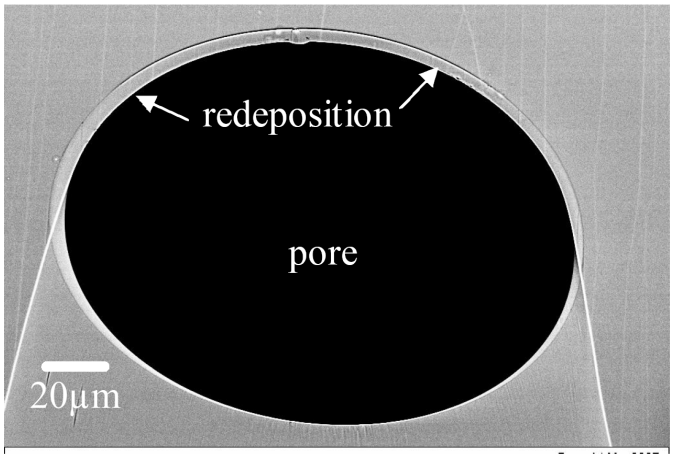

Figure 4. Material, sputtered by means of the Ar ion beam, is redeposed inside the pores.

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