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# Investigation of the Interaction of a $Ga^+$ Focused Ion Beam with Zirconia by Electron Backscatter Diffraction

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The interaction of a $Ga^+$ focused ion beam with zirconia materials (Mg-PSZ, Y-PSZ) was investigated with the aim to identify suitable parameters for the sample preparation for surface sensitive analytical methods such EBSD. The FIB parameters glancing angle (angle between ion beam and surface) and applied power (defined by acceleration voltage and ion current) were varied between two levels.

It was observed that the phase stability of monoclinic zirconia depended strongly on the FIB treatment parameters [1-2]. For a glancing angle of 5° and an applied acceleration voltage of 30 kV with an ion current of 30 nA a transformation of originally monoclinic grains to the tetragonal/cubic phase took place (Fig. 1). This was related to the implantation of $Ga^+$ ions and their presence as $Ga_2O_3$ which works as stabilizer for the high temperature phases of zirconia [3-4].

Furthermore, the statistical analysis yielded that the influence of the FIB parameters on the surface quality corresponded well to the literature. The data showed that mild parameter levels (lower glancing angle und lower power of the ion beam, such as 5° and acceleration voltage of 5 kV combined with ion current of 4.8 nA, respectively) reduced the surface damage.

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[2] N. Brachhold, H. Berek, J. Fruhstorfer, C.G. Aneziris; *Focused Ion Beam Parameters for the Preparation of Oxidic Ceramic Materials;* Advanced Engineering Materials 23 (**2021**), 2001235.

[3] A. Surpi, E. Göthelid, T. Kubart, D. Martin, J. Jensen; *Localised modifications of anatase $TiO_2$ thin films by a Focused Ion Beam;* Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms 268 (**2010**), 3142.

[4] T. Yamamoto, A. Kurimoto; *Ga Ion-doped $ZrO_2$ Catalyst Characterized By XRD, XAFS, and 2-butanol decomposition;* Analytical Sciences 36 (**2020**), 41.

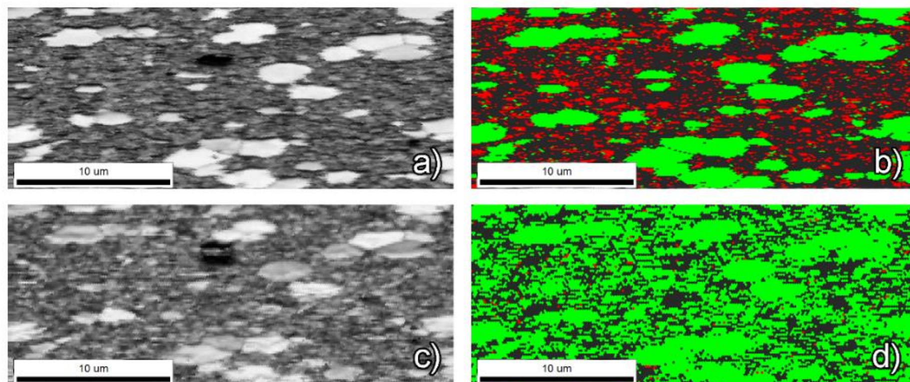


Fig. 1: Image quality (a, c) and phase distribution (b, d – red: monoclinic $ZrO_2$, green: cubic/tetragonal $ZrO_2$) of Y-PSZ, (a,b) initial state, (c,d) state after a $Ga^+$ FIB treatment at 30 kV and 30 nA with a glancing angle of 5°