MS44-1-8 Local strains in aluminium titanate polycrystalline materials
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Abstract
Polycrystalline materials based on aluminium titanate exhibit very low thermal expansion [1] and therefore have a very good thermal shock resistance [2]. Accordingly, they are mainly used for very high temperature applications.The β-Al_2TiO_5 phase crystallizes under the orthorhombic *Cmcm* space group and has anisotropic thermal expansion related to its structural characteristics, with a negative linear thermal expansion along the lattice axis [3]. This strong thermal anisotropy leads to a complex system of internal stresses and cracks (see Fig.1a) in polycrystalline aluminium titanate materials synthesized by high temperature sintering [4]. Moreover, β-Al_2TiO_5 phase decomposes into α-Al_2O_3 (alumina) and TiO_2 (rutile) by eutectoid reaction at 1300 °C [5]. However, it can be stabilized at room temperature through the formation of residual stresses or solid solutions containing various cation (Fe^{3+}, Mg^{2+}, etc.). In polycrystalline materials, the strains and the formation of solid solutions thus leads to metastable states, which are usually far from thermodynamic equilibrium. Understand the influence of such out of equilibrium situation on the decomposition process of β-Al_2TiO_5 and the formation of microcracks require multiscale investigations from the crystal size to the microstructure scale [2,6].
We investigated local strains on polycrystalline aluminium titanate samples by X-ray Laue microdiffraction at room temperature. Experiments were performed on ESRF beamline BM32 [7]. Thanks to the development of a new data reduction method based on the use of a neural network [8], we were able to index and extract the components of the deviatoric strain tensor online. Mapping at the sub-micrometric scale of the spatial evolutions of the strain tensor was measured (see Fig. 1b) and the strain components level distributions over the probed sample area are reported in Fig. 2.
We will illustrate through this communication, the influences on the strain state of both nature of the doping cations (Si^{4+}, Mg^{2+}, Fe^{3+}, Zr^{4+}) and the thermal treatments used in the elaboration process of different powdered or bulk samples.

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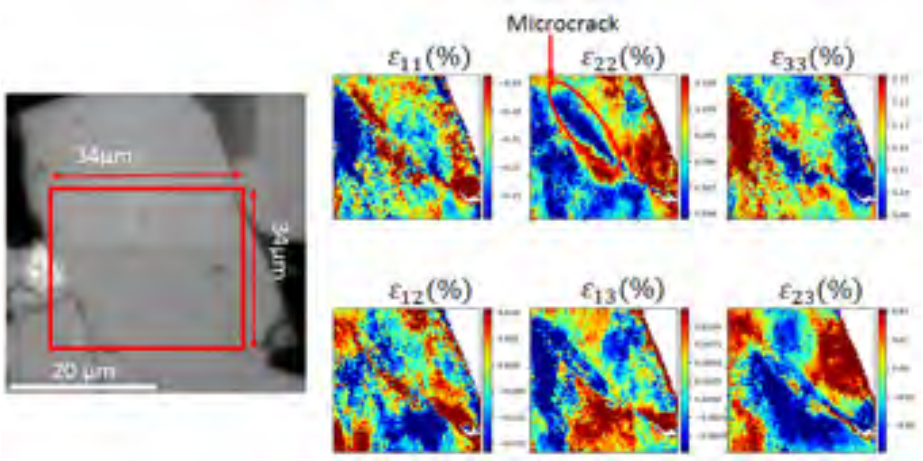
Observation of a crack



Deviatoric strain distributions