Geophysical Research Abstracts
Vol. 17, EGU2015-3706-1, 2015
EGU General Assembly 2015

Preliminary 3D *In-situ* measurements of the texture evolution of strained H_2O ice during annealing using neutron Laue diffractometry

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Dynamic recrystallization (DRX) strongly affects the evolution of microstructure (grain size and shape) and texture (crystal preferred orientation) in materials during deformation at high temperature. Since texturing leads to anisotropic physical properties, predicting the effect of DRX is essential for industrial applications, for interpreting geophysical data and modeling geodynamic flows, and predicting ice sheet flow and climate evolution. A large amount of literature is available related to metallurgy, geology or glaciology, but there remains overall fundamental questions about the relationship between nucleation, grain boundary migration and texture development at the microscopic scale.

Previous measurements of DRX in ice were either conducted using 2D *ex-situ* techniques such as AITA [1,2] or Electron Backscattering Diffraction (EBSD) [3], or using 3D statistical *ex-situ* [4] or *in-situ* [5] techniques. Nevertheless, all these techniques failed to observe at the scale of nucleation processes during DRX in full 3D.

Here we present a new approach using neutron Laue diffraction, which enable to perform 3D measurements of *in-situ* texture evolution of strained polycrystalline H_2O ice ($>2\%$ at 266 K) during annealing at the microscopic scale. Thanks the CYCLOPS instrument [6] (Institut Laue Langevin Grenoble, France) and the intrinsic low background of this setup, preliminary observations enabled us to follow, in H_2O ice, the evolution of serrated grain boundaries, and kink-band during annealing. Our observations show a significant evolution of the texture and internal misorientation over the course of few hours at an annealing temperature of 268.5 K. In the contrary, ice kink-band structures seem to be very stable over time at near melting temperatures. The same samples have been analyzed *ex-situ* using EBSD for comparison.

These results represent a first step toward *in-situ* microscopic measurements of dynamic recrystallization processes in ice during strain. This experiment has been conducted in the frame of the ANR-funded DREAM project that focuses on the recrystallization processes in anisotropic materials.

References

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