BIO Web of Conferences **129**, 27012 (2024) https://doi.org/10.1051/bioconf/202412927012
*EMC 2024*

# Room temperature viscoplastic response of amorphous olivine films revealed by ex/in-situ TEM nanomechanical testing

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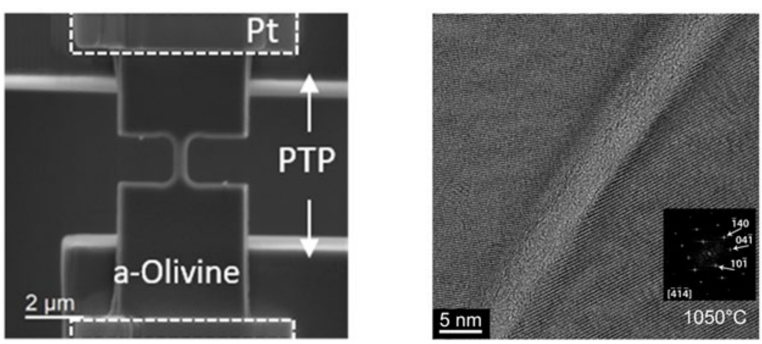
Olivine is a silicate which controls the rheology of the Earth's mantle down to ca. 410 km depth. Recently, we have discovered a new deformation mechanism of olivine where grain boundary sliding involves amorphization of grain boundaries under high stresses and further plastic flow along this amorphous layer [1]. We are convinced that this mechanism has a fairly general application to hard materials under conditions of high stress. This idea has been previously advocated by Idrissi et al. [2]. In the present case of olivine, the implications are mainly in the lithosphere in a ductile brittle context and at the boundary between the lithosphere and the asthenosphere. This led us to characterize the mechanical properties of amorphous olivine, but this material is mostly available in the form of thin films. It is therefore necessary to employ nanomechanical techniques: nanoindentation, in-situ TEM deformation and Lab-on-Chip (Figure 1). These tests have in particular the capacity to extend the solicitations to very low deformation rates relevant in geodynamics. Advanced TEM characterizations have allowed to identify the underlying microscopic mechanisms either in-situ or in ex-situ deformed samples. These data will allow in the future to feed mesoscopic mechanical models of olivine-rich rocks of the upper mantle. We also observe a significant influence of the electron beam on the viscoplastic behaviour of amorphous olivine. Special attention was paid to elucidate the origin of such feature.

**Graphic:**




**Keywords:**

TEM, Olivine, Nano-mechanical testing, Lab-on-chip

**Reference:**

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