European Mineralogical Conference
Vol. 1, EMC2012-699, 2012
European Mineralogical Conference 2012

Transmission electron microscopy of large $MgSiO_3$ perovskite single crystals.

N. Miyajima and T. Katsura
Bayerisches Geoinstitut / University Bayreuth, Bayreuth, Germany (Nobuyoshi.Miyajima@uni-bayreuth.de)

Current development in high pressure and high temperature techniques allows us to synthesize a large single crystal $MgSiO_3$ perovskite (MgPv). The large single crystal is necessary for the accurate determination of their physical properties, such as elasticity, plasticity and transportation properties. Especially, it is important to characterize defect structures of the single crystal for further deformation studies at high pressures and high temperatures (e.g., Dislocation recovery experiments). However, a number of obstacles have been encountered in the study of the silicate perovskites, owing to their intrinsic instability at low pressure conditions (e.g., ambient conditions). Here we report defect characterizations of synthetic large single crystals of MgPv at 25 GPa and 1500 ˚C, using a Kawai-type multi-anvil press, by following a recipe of Shatskiy et al. (2007). We have performed optical microscopy and transmission electron microscopy of the recovered single crystal of MgPv.

In TEM sample preparations, a conventional Ar-milling technique was used with and without a Liquid-Nitrogen cooling stage in the Gatan Dual Ion Mill and the Gatan Precision Ion Polishing System (PIPS), respectively. Conventional TEM observations by Bright-field, dark-field and weak-beam dark-field imaging techniques with a liquid nitrogen-cooling holder was performed in a 200 kV-transmission electron microscope (Philips CM20FEG) at Bayerisches Geoinstitut. The defect microtextures can be compared with those of polycrystalline $MgSiO_3$ perovskite and a $CaIrO_3$ perovskite analogue (Miyajima et al., 2009; Miyajima&Walte, 2009).

The polarized light microscopy of the petrological thin sections displays a low retardation, {110} twins and some mineral inclusions of MgO and ringwoodite, which were later identified by TEM. The electron-transparent foils of the crystalline silicate perovskite were successfully Ar-thinnned by both Ar-milling techniques at a low temperature and ambient temperatures. The weak-beam dark-field TEM images display very low density of dislocations and {110} twins. For example, the density of the [010] dislocation is further less than 2 x 10^{10} [m^{-2}].

References.

Miyajima et al. (2009) Dislocation microstructures of $MgSiO_3$ perovskite at a high pressure and temperature condition, *PEPI*, 174, 153.

Miyajima & Walte (2009) Burgers vector determination in deformed perovskite and post-perovskite of $CaIrO_3$ using thickness fringes in weak-beam dark-field images. *Ultramicroscopy* 109, 683

Shatskiy et al. (2007) Growth of large (1 mm) $MgSiO_3$ perovskite single crystals: A thermal gradient method at ultrahigh pressure, *Am. Mineral.*, 92, 1744.