

From Nature to materials science: (Cs,K)Al₄Be₅B₁₁O₂₈ (londonite) as a super-hard material

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Londonite is a rare Cs-bearing mineral with ideal chemical formula (Cs,K)Al₄Be₄(B,Be)₁₂O₂₈ (with Cs > K). The building block units of the structure of londonite are represented by clusters of four edge-sharing Al-octahedra linked to B- and Be-tetrahedra. Gatta et al. (2011) investigated the phase stability and the elastic behavior of londonite up to 4.85(5) GPa (at room-*T*) and up to 1000°C (at room-*P*) by *in situ* X-ray powder diffraction data, but no structure refinements were possible. Whether no phase transition was observed within the pressure-range investigated, londonite proved to have an extremely high bulk modulus: $K_{P0} = 280(12)$ GPa, similar to those of carbides (*e.g.*, B₄C with $K_{P0} \sim 245$ -306 GPa; Lazzari et al., 1999; Fujii et al., 2010). Considering the thermo-elastic properties and the significantly high fraction of boron (B₂O₃ ~50 wt%), the synthetic counterparts of londonite could be considered a potential inorganic host for ¹⁰B in composite neutron-absorbing materials. Furthermore the high content of Cs makes londonite-type materials potential host for nuclear waste. However, to date, because of the absence of structural data at high pressure and to the modest *P*-range investigated by Gatta et al. (2011), a comprehensive description of the *P*-induced deformation mechanisms at the atomic scale is still missing. In this study, the isothermal compressional behaviour of londonite is studied by *in situ* single-crystal synchrotron X-ray diffraction experiment with a diamond anvil cell up to 25 GPa. The compressional behavior and the deformation mechanisms at the atomic scale are described. Londonite does not experience any phase transition or change of the compressional behavior within the *P*-range investigated.

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