

Dislocation Creep at Low Stresses and High Temperature: Harper-Dorn Creep Revisited

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This study investigates the deformation mechanism operational in the high temperature-low stress creep, also known as the Harper-Dorn creep, in LiF single crystal. After long term annealing at high temperature, a frustration dislocation density is observed in these crystals. This frustration density restricts any further refinement of network density. An exponent of 1.5 is observed for LiF (see Fig. 1a). Due to the inability of the network to further refine itself, a stress independent dislocation density is observed in Harper-Dorn creep (see Fig. 1b). However, crystals initially grown with quite low dislocation density, which is below this frustration limit, may show a stress dependence at such low stresses. The observed creep exponent can be observed to be between 1 and 3 in the Harper-Dorn creep regime based on the initial dislocation density. A model which is based on the higher dependence of dislocation climb velocity on the applied stress is presented to explain the creep exponents observed in Harper-Dorn as well as 'five' power-law creep.

Keywords: Harper-Dorn creep; Ionic solids; Single crystal; Dislocation density; LiF

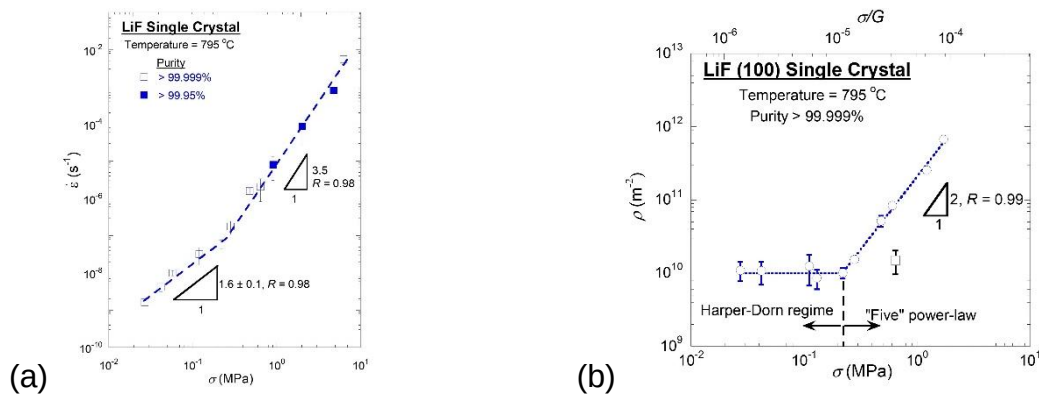


Fig. 1: Variation of steady-state (a) strain rate and (b) dislocation density as function of stress for LiF.

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