Shear modulus of solid $^3$He in the bcc and hcp phases\textsuperscript{1} JOHN BEAMISH, ZHIGANG CHENG, FABIEN SOURIS, University of Alberta — The shear modulus of solid hcp $^4$He decreases significantly at temperatures above 100 mK [1, 2]. This is due to dislocations which are localized when pinned by $^3$He impurities at low temperature but become mobile when $^3$He impurities “evaporate” at high temperature. The unpinned dislocations move freely in the basal plane of the hcp structure. This produces anisotropic and extraordinarily large softening of the shear elastic constant $C_{44}$, an effect referred to as “giant plasticity” [2]. Previous measurements [3] on solid $^3$He showed similar shear modulus changes in the hcp phase but not in the bcc phase. Here, we report new shear modulus measurements in both the bcc and hcp phases. $^3$He. These show a similar shear modulus anomaly in the bcc phase, indicating that dislocation softening is not unique to hcp phase of helium. We compare our results for bcc and hcp $^3$He to those hcp $^4$He, and discuss the roles that lattice structure and quantum statistics play in dislocation motion and impurity pinning.


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