Haziot *et al.* Reply: The model presented by Zhou *et al.* in the preceding Comment [1] is inconsistent with the measurements we reported in Ref. [2], although it may be relevant to experiments involving much larger deformations.

The most striking inconsistency concerns the dependence of the shear modulus on the driving strain and the ^{3}He concentration. Zhou *et al.* ignore that the stiffness of ^{4}He crystals is highly sensitive to ^{3}He impurity concentration, an experimental fact that is well established since the work of Day and Beamish [3]. In our Letter [2], Fig. 2 shows that the transition temperature from a soft to a stiff state is shifted to a much lower temperature if the ^{3}He concentration is reduced from 300 to 0.4 ppb, and Fig. 5 shows a crystal—$X4$—where all ^{3}He impurities have been expelled in the adjacent liquid and which remains soft down to 20 mK even at very low driving strain. Since Zhou *et al.* claim that the stiffness and dissipation can be explained without the need for ^{3}He, let us compare their Fig. 1(c) with our measurements on $X4$ at 20 mK (Fig. 1). On a strain domain from 8×10^{-11} up to 1.5×10^{-7}, $X4$ shows a perfectly linear variation of the stress with no sign of any yield strain and a slope 5 times smaller than the intrinsic shear modulus (their initial slope). By replacing the effect of impurity binding by that of network pinning or Peierls barriers, Zhou *et al.* arrive to a striking contradiction with experiments.

Zhou *et al.* assume the existence of a yield strain 2.7×10^{-8} due to network pinning so that the transition temperature from soft to stiff changes drastically as a function of the applied strain [see Fig. 3(a) in Ref. [4]] and of the dislocation density (see Fig. 4 in Ref. [5]), again in contradiction with our experiments [2,6,7].

Zhou *et al.* show no results on the dependence on ^{3}He concentration but they consider that our results are "not sufficient evidence for the process of ^{3}He atoms binding to dislocations." All our measurements are consistent with a stiffening due to the binding of ^{3}He impurities, especially the most recent ones [7].

From the imaginary part of the response to an ac drive [6], we have shown that dislocations move with no measurable dissipation in the "giant plasticity" regime. It is an experimental fact in contradiction with their model.

Zhou *et al.* assume that dislocations unbind from network nodes and that new dislocations are created beyond a yield strain 2.7×10^{-8}. However, in hcp crystals, pinning at nodes is normally much stronger than impurity pinning, so that dislocations should move only between the nodes in our case unless a very high strain is applied. How would these dislocations disappear during the sub-ms period of our ac strain, to give us the reversible, zero dissipation behavior we observe? In Ref. [6], we show that the dislocation density is stable, reproducible for a given crystal, and independent of time and of strain amplitude. We also find a dislocation displacement that is much smaller than the interdislocation distance [6]. We work far below any threshold for dislocation creation, even when we measure the stress corresponding to break away from ^{3}He impurities. We have observed irreversible behavior that could be related to the creation of jogs on dislocations, but only at strain values that are orders of magnitude larger than in Ref. [2].

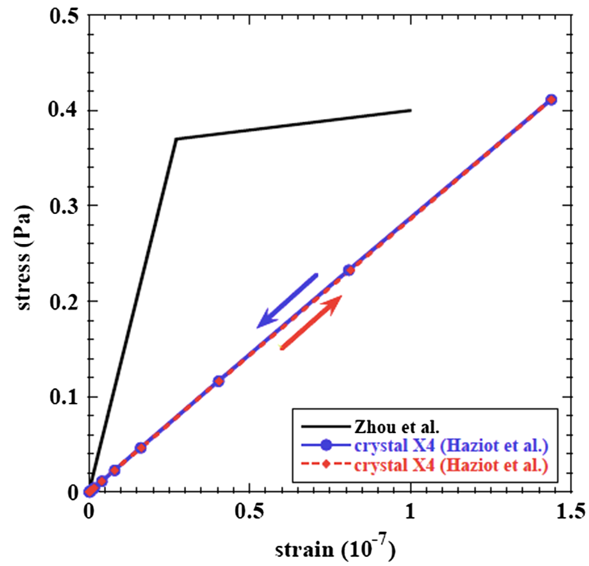

FIG. 1 (color online). The theory by Zhou *et al.* shows strong disagreement with our experiments. We observe [2] a linear and reversible behavior with highly reduced stiffness down to 8×10^{-11} strains, 300 times smaller than their yield strain (2.7×10^{-8}).

In their summary, Zhou *et al.* claim that our results "can be explained without requiring quantum tunneling or dissipationless motion of dislocations." We carefully chose the title "Giant Plasticity of a Quantum Crystal" rather than, for example, "Quantum Plasticity in Solid Helium," a description which has been used in the past. We explained in Ref. [2] that "an interesting question is whether dislocations move by quantum tunneling or by thermal activation..." because this is an open question.

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