Comment on "Superdiffusion of 4*T*-Hydrogen in Vanadium"

In the recent Letter by Suzuki *et al.*[1] it is claimed that diffusion of H under elastic stress along ⟨111⟩ in V is as much as sixty times larger than the normal value. Also, it is stated that a remarkable anelastic deformation takes place when ⟨100⟩ single crystals are deformed in the elastic region. These effects are ascribed to a transformation from the usual 1*T* to the 4*T* site in which hydrogen is delocalized via tunneling. We have made two critical experiments to check on the above results. First, we have measured at 20 °C the hydrogen diffusivity in a $VH_{0.015}$ single crystal as a function of elastic stress σ applied along ⟨111⟩. In this Gorsky-type experiment, the plate is deformed elastically by the force F while under the longitudinal stress σ. When the force F is taken off, the surface strain ϵ^s (as measured with a strain gauge[2]) decays exponentially with a time constant τ directly related to the diffusivity. Therefore, the diffusivity was measured in the perpendicular $[1\bar{1}0]$ direction [Fig. 1(a)]. The resulting diffusivities are within ±10% independent of applied elastic stress up to a stress of 75 MPa and agree well with the literature value at 20 °C. In the second experiment we have precisely measured in tension the stress-strain curve of a ⟨111⟩ $VH_{0.015}$ single crystal. The geometry was similar to the one in Fig. 1(a). A second strain gauge was applied to the backside to compensate for possible bending moments. The aim was to detect any anelastic effects in the same geometry as used by Suzuki *et al.*[1] in their diffusion experiment. Figure 1(b) shows that Hooke's law was obeyed up to stress levels of 75 MPa. The slope was found to be independent of applied stress within experimental limits (±~1%) and Young's modulus was found to be in good agreement with the literature value for our single-crystal geometry.

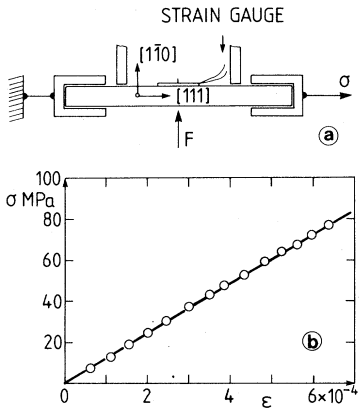

FIG. 1. (a) Geometry for the diffusion measurements under an applied stress σ; (b) stress-strain curve of a ⟨111⟩ $VH_{0.015}$ single crystal. No deviation from Hooke's law was detected.

We conclude that the negative results of the above experiments are in contradiction to some of the conclusions reached by Suzuki *et al.*[1] If there would be a three-dimensional network of 4*T* sites one would expect enhanced diffusion in our experiment along $[1\bar{1}0]$ and also anelastic effects along [111]. A final model of the alleged 4*T* states should also explain the present experiments.

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[2]T. Schober, to be published.