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High Strain Rate Effects on the Deformation of Vanadium Nanowires XIANDONG DING, Los Alamos National Laboratory, SUZHI LI, Xian Jiaotong University, XIAOBING REN, National Institute for Materials Science, TURAB LOOKMAN, Los Alamos National Laboratory — Dislocation glide and deformation twinning are the two major plastic deformation modes in b.c.c. metals and alloys. In bulk materials, dislocation motion is usually dominant at high temperatures and for low strain rates, and deformation twinning is dominant under extreme conditions of high strain rates or very low temperatures. However, at nanoscales it is not clear if the behavior of the b.c.c metal is similar to the bulk. Moreover, the corresponding atomistic mechanisms which govern the choice of deformation modes are not established. In the present study, we study the effects of strain rate on the tensile deformation response of b.c.c. Vanadium nanowires by molecular dynamics simulations using an EAM potential. We find that with the increasing strain rate, the deformation mode changes form dislocation slip to a combination of dislocation slip and deformation twinning. At sufficiently high strain rates, (112)[-1-11] deformation twins are only formed in the nanowire. In addition, the yield strength of the V nanowire increases with strain rate. Interestingly, the ductility of the nanowire also increases with the increasing strain rate, and the plastic strain at very high strain rates can be almost completely recovered (up to 40%). Analysis of the multi-layer generalized stacking fault energies shows that this phenomenon can be understood in terms of the nucleation.

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