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Micromechanisms of shock-induced twinning and martensitic transformation in bcc metals LUKE HSIUNG, Lawrence Livermore National Laboratory — Shock-induced twinning and martensitic transformation in bcc metals and alloys (Ta, Ta-10wt% W and U-6wt% Nb) have been studied using transmission electron microscopy (TEM). The length-scale of domain thickness for both twin lamella and martensite (or omega) phase is found to be smaller than 100 nm. While deformation twinning of {211}<111>-type is found to occur in Ta when shock-deformed at 15 and 45 GPa, martensitic transformation is found to occur when shock-deformed at 45 GPa. Similar phenomena of nanoscale twinning and martensitic transformation are also found within U6Nb shock-deformed at 30 GPa. Since both deformation twinning and martensitic transformation occurred along the {211} planes in association with high resolved shear stresses, it is suggested that both twinning and martensitic transformation can be regarded as alternative paths for shear transformations occurred in shock-deformed bcc metals. Heterogeneous nucleation mechanisms based upon a dislocation clustering reaction, which causes a localized mechanical instability, are proposed to rationalize the shock-induced twinning and martensitic transformation.

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