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Investigating deformation mechanisms in shock compressed tantalum via femtosecond diffraction DAVID MCGONEGLE, MARCIN SLIWA, JUSTIN WARK, University of Oxford, UK, CYNTHIA BOLME, Los Alamos National Laboratory, ANDREW HIGGINBOTHAM, University of York, UK, AMY JENEI, HYE-SOOK HYE-SOOK, BRUCE REMINGTON, ROB RUDD, DAMIAN SWIFT, CHRIS WEHRENBERG, LUIS ZEPEDA-RUIZ, Lawrence Livermore National Laboratory, HAE JA LEE, BOB NAGLER, SLAC National Accelerator Laboratory — When materials are compressed beyond their Hugoniot elastic limit, they act to relieve built up shear stress by deforming plastically. Tantalum provides an interesting case to study owing to its multitude of competing plasticity mechanisms, a combination of dislocation flow (slip) and deformation twinning. We present the first direct, in-situ observation of twinning in shock-compressed metals using femtosecond x-ray diffraction performed at the MEC beamline at LCLS. Tantalum with an initial (110) fiber texture was subjected to shock compression in the 10-300 GPa pressure range at strain-rates above $10^9 \mathrm{s}^{-1}$ and the ultrafast texture evolution was recorded via in-situ, time-resolved x-ray diffraction. The onset of twinning was observed at 25 GPa, reaching a twin-dominated response for shock strengths of $\sim$50-75 GPa. At high shock pressure (>150 GPa) the twin fraction is lower and the response is slip dominated. These results compare favourably with molecular dynamics simulations performed using the Ravelo EAM potential, which also show a twin-slip transition.

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