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Transition Metals under Extreme Conditions Studied using Chemical Vapor Deposited Nanocrystalline Diamond Micro-Anvils[1] YOGESH VOHRA, SAMUEL MOORE, GEORGIY TSOI, GOPI SAMUDRALA, University of Alabama at Birmingham — The use of nanocrystalline diamond (NCD) micro balls in diamond anvil cells have generated static pressures close to 1000 GPa (1 TPa) in a two-stage compression. An inherent difficulty with this technique is the precise alignment and placement of these NCD micro balls in a sample assembly in diamond anvil cell devices. We have developed a novel technique where these NCD structures are directly grown on an existing diamond anvil with the precision delivered by the projection lithography. The NCD diamond micro-anvil is grown using a microwave plasma chemical vapor deposition on areas defined by a tungsten mask utilizing mask-less lithography. The NCD structures were grown on a diamond anvil and tested in a two-stage compression in a diamond anvil cell and the pressures were determined using x-ray diffraction at HPCAT beamline 16-ID-B, Advance Photon Source. In a series of experiments, transition metals Tungsten (W) was compressed to 264 GPa, Rhenium (Re) was compressed to 500 GPa, and Osmium (Os) was compressed to 253 GPa. X-ray transmission scans and pressure profile measurements indicate that the NCD anvil can support large pressure gradients and retain their structural integrity to extreme conditions. A further optimization of NCD geometry and diamond grain size can lead to even higher pressures in diamond anvil cell devices.

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