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High P-T Constitutive Properties and nanoMechanics YUSHENG ZHAO, LANSCE - Lujan Center, Los Alamos National Laboratory; 2. HiPSEC, University of Nevada Las Vegas, JAINZHONG ZHANG, LANSCE - Lujan Center, Los Alamos National Laboratory, XIAOHUI YU, YUEJIAN WANG, 1. LANSCE - Lujan Center, Los Alamos National Laboratory, ZHIJUN LIN, 1. LANSCE - Lujan Center, Los Alamos National Laboratory; 3. Geophysical Laboratory, Carnegie Institution of Washington, 1. LANSCE - LUJAN CENTER, LOS ALAMOS NATIONAL LABORATORY TEAM, 2. HIPSEC, UNIVERSITY OF NEVADA LAS VEGAS TEAM, 3. GEOPHYSICAL LABORATORY, CARNEGIE INSTITUTION OF WASHINGTON TEAM — Nano-crystalline materials show drastic differences in physical properties compared with their bulk counterparts under high pressure (P) and temperature (T) conditions. We show a model to explain the observed contrasts between nano-metals and nano-ceramics, in the sense that the surface tension and compression of nanocrystals are the underlying cause of the differences in elasticity, yield strength, and work hardening and weakening. This nano-mechanics model has been tested by the comparative study of constitutive property and elastic modulus of nano-/micron- crystalline materials under high pressure and high temperature conditions. These studies provide fundamental understanding for metal/ceramics performances at nano-scales.

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