Negative linear compressibility and tuneable phase transition sequence in selenium and selected high entropy oxides under high pressure conditions via compressional rate control

Lisa Luhongwang Liu¹,², Arthur Haozhe Liu³

¹. University of Illinois at Urbana Champaign, IL, 61801, USA
². SHARPS, Shanghai, 201203, China
³. HPSTAR, Beijing, 100094, China
Haozhe.liu@hpstar.ac.cn, lisaliu@illinois.edu

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The behaviour of crystalline materials under high pressure extreme conditions attracted great deal of interest. Unusual behaviour, such as various types of negative linear compressibility (NLC) were reported but not fully understood. NLC is a rare phenomenon where a crystal expands along one direction under hydrostatic compression. In this presentation, several selected systems were in situ studied in diamond anvil cell (DAC) under high pressure using synchrotron x-ray diffraction at over 100 GPa conditions. For example, in selenium case, the two types of NLC mechanism were found at various pressure regions, i.e. at around 10 GPa, and around 120 GPa, respectively, in this same elemental sample [1, 2]. By adjusting the compressional rate, from relatively slow at about 0.5 GPa/s to relatively fast at over 200 GPa/s in dynamic DAC, the modified or even disappearance of NLC behaviour and tuneable phase transition sequences were discovered in selenium and selected high entropy oxides, which reveal the kinetic effect of the compressional rate on the NLC and phase boundaries under strong compression.

Figure 1. Schematism of geometrical interpretation of negative linear compressibility in the structures of phase (a) Se-V⁺; (b) Se-I at around 120 GPa and 10 GPa, respectively.


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