Poster

Pressure induced transitions in two types of engineering oxides

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In this presentation, two types of selected engineering oxides, including doped nano oxide and high entropy oxides (HEO) will be introduced for their novel pressure induced phase transition behaviours. In order to detect the local structure distortion and potential phase transition under pressure, in situ high-pressure Raman spectra were measured in a diamond anvil cell (DAC) at room temperature. The in situ high pressure synchrotron X-ray diffraction (XRD) experiments were carried out, to reveal the pressure induced phase transitions. The gradient doping of Nb elements from the surface to the bulk changes the microchemical structure of nano CeO_2, i. e. generating more Ce^{3+} and oxygen vacancies at the interface, inducing a continuing transition to orthorhombic phase at lower pressure on the surface layer during compression and decompression process. The direction of phase transition is not affected by pressure release until the pressure drops to ~17 GPa. The obtained orthorhombic phase is found to be unquenchable. The unconventional phase transition behavior explained by this work deepens our understanding of the physical and chemical properties of doped nanomaterials. HEO are single-phase oxides composed of muti-elements developed from high entropy alloys. The compositional flexibility of HEO provides infinite possibilities for the application of high entropy oxides in various fields. By taking advantage of the potential cocktail effect of HEO, we designed and synthesized rutile-type HEO (Ti-Fe-Ta-Sn-Ge-O_2) and its referenced samples (Ti-Fe-Ta-O_2 and Ti-Fe-Ta-Sn-O_2) by solid-phase method. The structures and properties of these HEOs were analysed by XRD, SEM, high resolution TEM, X-ray absorption spectra, Raman and UV-VIS, and heat capacity measurements, to reveal their disorder, local lattice strain, and entropy features. Although the structural transition under high pressure of conventional rutile TiO_2 has been extensively studied, the influence of high configuration entropy on the structural stability of rutile-type HEO under high pressure conditions offer us new opportunity to discover the unconventional phase transition sequence upon compression.

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