

Ultra-high-pressure synthesis and applications of nano-polycrystalline ceramics; current status and future perspective

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Since our first report of ultrahard nano-polycrystalline diamond (NPD = Hime-diamond), efforts have been directed to synthesize NPD samples of larger dimensions and higher quality with improved mechanical and optical properties. Applications of NPD to the anvils of various high-pressure apparatus have been attempted, leading to some successful results in ultra-high pressure generation and other cutting-edge studies under pressure. We also recently succeeded to synthesize nano-polycrystalline garnet (NPG, tentatively nicknamed as “Hime-garnet”) as the very first successful “transparent nano-ceramics” using the ultrahigh-pressure techniques similar to those adopted in producing Hime-diamond. Here I will showcase our recent achievements in the syntheses of such nano-polycrystalline ceramics, and discuss agendas and future directions to the science and technology of these novel functional materials created utilizing the multianvil technology developed in geoscience.