Synthesis of transparent nano-ceramics at high pressure and temperature

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Abstract

Since the successful synthesis of transparent nano-polycrystalline diamond (NPD) by direct conversion from various forms of graphitic carbon in Kawai-type Multianvil Apparatus (KMA), we have been applying similar techniques to the synthesis of well-sintered polycrystalline bodies of some high-pressure phases. Synthesis of highly transparent nano-polycrystalline materials ("transparent nano-ceramics") has been successfully made at the ultrahigh-pressure (> 10 GPa) regime under moderate temperatures, which is attributed to a combination of rapid nucleation and slow grain growth under such conditions. Some of these ceramics have optical transparencies equivalent to those of corresponding single crystals and advanced mechanical properties in both hardness and toughness. These novel ceramics of high-pressure phases should be important for measurements of some key physical properties relevant to deep Earth mineralogy, as well as for some industrial applications such as ultra-hard materials and optical devices.

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