The 500th Geodynamics Seminar

Optical and mechanical properties of nano-polycrystlline ceramics synthesized under ultra-high pressure: Toward science and technology of “transparent nano-ceramics”

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Since our first report of successful synthesis of nano-polycrystalline diamond (NPD = Hime-diamond), efforts have been made to synthesize polycrystalline aggregates of various high-pressure phases under ultra-high (>10 GPa) pressure and high temperature in Kawai-type multianvil apparatus. These include NPDs with different fine structures, SiO_2 stishovite, cubic BN, cubic Si_3N_4, $Ca_3Al_2Si_3O_{12}$ grossular and other silicate garnets, Al_2SiO_5 kyanite and its higher-pressure forms, etc. Many of these materials are of nano-crystalline nature and exhibit high optical transparency with enhanced hardness. As such transparent polycrystalline aggregates with nano-sized grains have never been produced by conventional sintering techniques at relatively low pressures, there remain a number of unknown issues relevant to their formation processes, fine structural features, and physical properties. Here I show some aspects of ultrahigh-pressure synthesis, optical properties, and compression behaviours of such materials for future creation of science and technology of “transparent nano-ceramics”.

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