High-pressure behavior of beta-Ga2O3 nanocrystals

Freestanding nanocrystalline beta-Ga2O3 particles with an average grain size of 14 nm prepared by chemical method was investigated by angle-dispersive synchrotron x-ray diffraction in diamond-anvil cell up to 64.9 GPa at ambient temperature. The evolution of x-ray diffraction patterns indicated that nanocrystalline monoclinic beta-Ga2O3 underwent a phase transition to rhombohedral alpha-Ga2O3. It was found that beta- to alpha-Ga2O3 transition began at about 13.6-16.4 GPa, and extended up to 39.2 GPa. At the highest pressure used, only alpha-Ga2O3 was present, which remained after pressure release. A Birch-Murnaghan fit to the P-V data yielded a zero-pressure bulk modulus at fixed B-0(\(')\)=4: B-0=228(9) GPa and B-0=333(19) GPa for beta-Ga2O3 and alpha-Ga2O3 phases, respectively. We compared our results with bulk beta-Ga2O3, and concluded that the phase-transition pressure and bulk modulus of nanocrystalline beta-Ga2O3 are higher than those of bulk counterpart.