Rietveld analysis of structural strains in microcrystalline quartz

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Structural strains of synthetic microcrystalline quartz and natural chalcedony were refined by the Rietveld method using synchrotron X-ray powder diffraction data. The diffraction data were collected by a multiple detector system at BL-4B2 in the Photon Factory, High Energy Accelerator Research Organization (KEK).

Microcrystalline quartz samples were synthesized from silica gel under hydrothermal solution of 0.1mol/l KOH at 473K, 15atm, with various duration of heating from 60 hours to 120 hours. Quartz synthesized by heating of 100 hours exhibits an euhedral form composed of {101} and {100} faces. Size of crystals are about 0.5-3um.

Chalcedony from Oguni, Yamagata prefecture, Japan, and chalcedony bearing moganite from Arz-bogd, Mongolia were examined as natural sample.

Computer program RIETAN-2000 was used for the Rietveld analysis with a profile function proposed by Tompson et al.(1987).

Adopting anisotropic strain perpendicular to {101} planes resulted least R factor with biggest anisotropy coefficient. All examined synthetic and natural samples show the same direction of anisotropic strain, despite the difference of occurrence, texture and crystallite size. The anisotropic strains are considered to be due to Brazil-low twin lamellae parallel to {101} planes, which exists in quartz crystals occurred in low-temperature hydrothermal conditions.

Cell parameter of each sample is bigger than that of perfect quartz crystals. Cell parameter of synthesized quartz expands isotropically with decrease of synthesizing temperature or duration of heating. Axial length of natural quartz expands along a-axis with increase amount of corresponding moganite in chalcedony like specimens.