

Simultaneous determination of mean pressure and deviatoric stress by powder x-ray diffraction of gold in diamond anvil cell

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In cubic crystals under pressure with deviatoric stresses, the hkl planes that involve 4-fold and 3-fold symmetric axes, such as 100 and 111, have strain responses that are free from the effect of lattice preferred orientations. This special character enables us to determine the mean pressure and deviatoric stress simultaneously and unambiguously by analyzing powder x-ray diffraction data obtained by in situ x-ray diffraction experiments due to the lattice preferred orientation. The usefulness of the present analysis was successfully verified by examining the experimental data of the Au pressure marker in a diamond anvil cell. The present analysis yields a mean pressure of ~0.3 GPa higher than that determined without taking the effect of the deviatoric stress into account. The deviatoric stress in gold was estimated to be less than 0.07 GPa in general, indicating that the Au pressure marker is sensitive to deviatoric stress.