Amorphization from the High-Pressure Phase in III-V Compounds

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The temperature dependences of phase transitions in III-V compounds have been studied by x-ray diffraction under high pressure and at low temperatures. The phase transitions depend on paths in a pressure-temperature phase diagram. As the transition depends on the height of potential barrier ΔU between the two phases of the before- and after-phase transitions, it is interesting to study the path dependence of the phase transition in III-V compounds with different strength and ionicity of bonds.

A diamond anvil cell with a diaphragm was cooled in a cryostat using a He refrigerator. Pressure in the sample was measured by a Ruby fluorescence method with an in-situ pressure measuring system. Pressure can be changed at low temperatures by controlling the He gas pressure in the diaphragm. Fig.1 shows the temperature and pressure where measurements were done. At 300K, pressure was 6 GPa at 21.0 bar of gas pressure in the diaphragm and 10 GPa at 26.9 bar. When the diamond anvil cell (DAC) was cooled down to 10 K with constant gas pressure, the pressure at the sample increased from 10.0 GPa to 16.9 GPa due to the large difference in the thermal expansion coefficients between diamonds and metallic body of DAC. With decreasing the gas pressure and increasing the temperature, the pressure at the sample decreased continuously to the normal pressure as shown in Fig.1.

On compression at 300 K , InAs with the zincblende structure transforms to the NaCl structure at about 6 GPa. When the pressure was decreased at low temperature, the high pressure phase was quenched to lower pressure than the transition pressure at 300K. With increasing temperature, the high pressure phase gradually transforms to the stable zincblende phase although the widths of the diffraction peaks are rather wider than those before the phase transitions.

These results with the angle-dispersive method are in good agreement with the results obtained with energy-dispersive method. The correction for the energy-dependent factors of the incident x-ray, absorption by the sample, efficiency of the detector is extremely small for the angle-dispersive method. Moreover, the resolution of d-value for the angle-dispersive method is smaller than that for the energy-dispersive method. Detailed analysis is in progress.

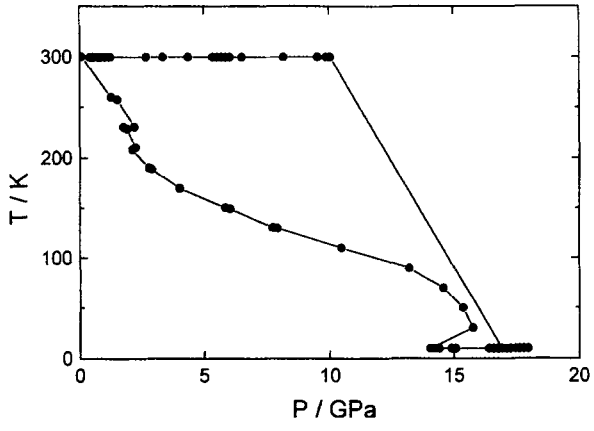

Fig.1 Pressure-temperature diagram for experiments