HIGH TEMPERATURE SUPERCONDUCTIVITY OF HIGHLY COMPRESSED MATERIALS

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High pressure is one of useful tools for studying material properties such as superconductivity. But, most of superconductors show a negative pressure dependence on the transition temperature, T_c. In my presentation, some superconducting examples in pure elements and simple compounds that show the positive dependence and relatively high value in their T_c by highly compressed conditions are reviewed.

It has been already revealed that not a few elements that are not the superconductor at ambient pressure became superconductive under combination of low temperature and high pressure. We found that some elements exhibit relatively high-T_c at high pressure. Most of the maximum T_c is recorded at ambient pressure, but the lest of them show rather higher temperature at pressure. In general, a lighter element has a possibility to show a higher T_c according to the conventional BCS theory. The most important example is metallic hydrogen, for which the appearance of superconductivity at room temperature is predicted theoretically[2]. However, experimental realization of metallic hydrogen has not yet been attained, at least by static compression using a diamond-anvil cell (DAC). The highest T_c in elements was found in compressed calcium[2] with 30 K at very high pressure exceeding 200 GPa.

Superconductivity exceeding 200 K was recently reported in the highly compressed hydrogen sulfide[3]. We performed the in-situ crystal structure analysis of the superconductor at the low temperature and high pressure by using the synchrotron x-ray in SPring-8. H_2S and D_2S were compressed to 150 GPa in DAC with same process with the resistance measurements[3], and cooled down to 10 K in the cryostat. The collected x-ray diffraction data showed good agreement with the theoretically predicted structures of *R*3m and *I*m-3m[4,5]. No structural difference was observed between at 10 K and room temperature.

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