Pressure-induced metallic phase transition in gallium arsenide up to 24.3 GPa under hydrostatic conditions

张新觊 [1,2]，代立东 [1*]，胡海英 [1*] 和 洪梅玲 [1,2]

1、中国科学院地球内部物质高温高压重点实验室 ,中国科学院地球化学研究所，贵阳，贵州，550081，中国；

2、中国科学院大学，北京，100049，中国

[*]E-mail: dailidong@vip.gyig.ac.cn 和 huhaiying@vip.gyig.ac.cn

A series of researches on the structural, vibrational and electrical transport characterizations for gallium arsenide (GaAs) were conducted up to 24.3 GPa under hydrostatic conditions in a diamond anvil cell in conjunction with *in-situ* Raman scattering spectroscopy, electrical conductivity measurements, high-resolution transmission electron microscopy and atomic force microscopy. Upon compression, a phase transition from the zinc-blende (zb) to orthorhombic (*Cmcm*) structure in GaAs was observed at the pressure of 12.2 GPa in the light of all of these discontinuous variations in the Raman shifts, the Raman full-width at half-maximum and the electrical conductivity, which is accompanied by a semiconductor to metal transition at the same pressure. And our acquired results on the temperature-variable electrical conductivity experiments further confirmed the high-pressure phase (*Cmcm*) to be of an obvious metallic behavior on the basis of the relationship between conductivity and temperature. Upon decompression, the Raman scattering results from the recovered GaAs at ambient conditions proved that the phase transition was reversible because of the recovered Raman peaks. The reversibility of the phase transition can be further disclosed by the HRTEM and AFM images of the recovered sample.

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