Photo-induced polymerization of nitrogen at multi-Mbar pressure.

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Effect of photo-induced polymerization of nitrogen in multi-Mbar pressure range is reported. Molecular nitrogen was transformed to different atomic phases using this effect.

Previous studies [1, 2] reported a pressure-induced transformation of molecular nitrogen N_2 to a non-molecular (polymeric, or atomic) state at pressure 130-170 GPa. Interpretation of high-pressure atomic phases is difficult, because the sample composes presumably from phase mixture [2]. Heating of the sample [3] leads to possible chemical reactions of nitrogen with diamond anvil. As result, structure study reveals principal contradictions between Raman and X-ray data.

In the present study molecular nitrogen was loaded in diamond cell up to 170 GPa without an initialization of transformation to atomic phase. At pressure 170 GPa the sample was completely opaque and black. There are only bands of molecular phase in the Raman spectra and no signs of atomic phase. The illumination of the samples at 130 and 170 GPa gives strong effect of the photo-induced polymerization: the intensities of the molecular modes drop and the characteristic bands of polymeric nitrogen appear in the Raman spectra. The photo-transformation at pressure 130 GPa leads to formation of cubic gauche phase [1], whereas the photo-transformation at 170 GPa leads to formation of another new phase. In the second case the photo-induced transformation is accompanied by pressure decreasing to 165 GPa, indicating a volume decreasing of the sample. Pressure increasing to 250 GPa gives no new features in the Raman spectra.

References:

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