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Mixed Nitrogen-Methane Solids at High Density SERGE DESGRENIERS, Laboratoire de physique des solides denses, University of Ottawa — Mixing different molecular species may yield weakly bound compounds or van der Waals solids upon the application of high pressure. Van der Waals solids differ in physical properties from solids formed by pure molecular species at comparable thermodynamic conditions. In this contribution, we present results of the formation of binary methane-nitrogen compounds at high density. Methane and nitrogen, with similar potentials and molecular size, are expected to be partly miscible in the condensed state. Using single crystal and powder X-ray diffraction with synchrotron radiation and vibrational spectroscopy, the pressure-concentration phase diagram for this system has been explored from 1 to 16 GPa, at room temperature. The existence of van der Waals solid phases for samples with concentrations above 10% (methane per volume) is demonstrated. For example, at 7.6 GPa and at room temperature, whereas pure nitrogen and methane exist in cubic and in rhombohedral structures, respectively, our study indicates that a methane-nitrogen sample with 60% nitrogen by volume exhibits, under the same conditions, a novel phase with a tetragonal symmetry. Other novel structures in methane-nitrogen samples with different concentrations under varying pressure conditions have also been observed and will be discussed.

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