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Novel High-Pressure C–N–H Phase: Implications for Deep Layers of Giant Planets

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The internal structure of ice giant planets, such as Neptune, remains poorly constrained yet is central to understanding their thermal evolution and magnetic field generation. We investigated the high-pressure chemistry of carbon–nitrogen–hydrogen (C–N–H) systems and synthesized a novel CN_2H_2 phase at ~35 GPa. The phase was characterized using single-crystal X-ray diffraction, Raman spectroscopy, and first-principles calculations. Structural analysis reveals a dense framework with a calculated density exceeding that of water-rich compounds under comparable pressure conditions. These results suggest that C–N–H compounds may form gravitationally stable layers within the mid-ice mantles of ice giant planets, contributing to chemical stratification and potentially influencing interior dynamics.