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Topological Node-Line Semimetal in Three Dimensional Graphene Networks HONGMING WENG, Beijing National Laboratory for Condensed Matter Physics, and Institute of Physics, Chinese Academy of Sciences, YUNYE LIANG, New Industry Creation Hatchery Center, Tohoku University, Japan, QIUNAN XU, Institute of Physics, Chinese Academy of Sciences, RUI YU, International Center for Materials Nanoarchitectonics (WPI-MANA), National Institute for Materials Science, ZHONG FANG, XI DAI, Beijing National Laboratory for Condensed Matter Physics, and Institute of Physics, Chinese Academy of Sciences, YOSHIYUKI KAWAZOE, New Industry Creation Hatchery Center, Tohoku University, Japan & Thermophysics Institute, Siberian Branch, Russian Academy of Sciences, Russia — Graphene, a two dimensional (2D) carbon sheet, acquires many of its amazing properties from the Dirac point nature of its electronic structures with negligible spin-orbit coupling. Extending to 3D space, graphene networks with negative curvature, called Mackay-Terrones crystals (MTC), have been proposed and experimentally explored, yet their topological properties remain to be discovered. Based on the first-principle calculations, we report an all-carbon MTC with topologically non-trivial electronic states by exhibiting node-lines in bulk. When the node-lines are projected on to surfaces to form circles, "drumhead" like flat surface bands nestled inside of the circles are formed. The bulk node-line can evolve into 3D Dirac point in the absence of inversion symmetry, which has shown its plausible existence in recent experiments.

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