
**Magnetism by nonmagnetic defects in a 2D BN sheet:
ab initio studies**

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This study attempts to resolve the following two issues: 1) whether a long-range magnetic order can be established in a material consisting of elements with only s and p valence electrons, 2) whether the magnetic properties, similar to the electrical properties, can be controlled through defects in the previous systems. Through studying different defects concentrations in a 2D system of BN sheet by the first-principles methods, we found in a previous study that, despite most of the defects doped BN sheet only lead to formations of local moments, there are systems exhibiting long-range ordered magnetic moments with estimated $T \approx 70\text{K}$ [1]. Our latest investigations demonstrate that a ferromagnetic free electron gas, i.e. ferromagnetism due to Stoner instability, is also possible to develop from these defect systems[2]. This result is contrary to the direct transition from paramagnetism to Wigner crystal in a 2D uniform electron gas established recently [3]. A contrastive study between this Stoner magnet, i.e. a defect system with N atoms replaced by O impurities (O_N), and a metallic ferromagnetic systems with localized moments throughout all the considered defect concentrations (Si_B) is carried out by studying their band structures and the corresponding partial density of states as well as the defect-concentration-dependent defect energies and magnetization energies. We also discuss the stability of this Stoner magnet with respect to different defect configurations (distributions and concentrations of defects), applied strains (compressive and tensile, possibly imposed by a supporting substrate) and atomic displacements towards the 3rd dimension.

[1] R-F. Liu and C. Cheng, Phys. Rev. B **76**, 014405 (2007)

[2] R-F. Liu and C. Cheng, to be published.

[3] N.D. Drummond and R.J. Needs, private communication, to be published.