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Effects of Magnetic Correlation of Localized Spins in Graphene
YURIY SEMENOV, JOHN ZAVADA, KOSTYANTYN BORYSENKO, KI WOOK KIM, Department of Electrical and Computer Engineering, North Carolina State University, Raleigh, NC 27695-7911 — Prior analysis of the indirect exchange interaction between localized spins (LS) in graphene reveals an alternate sign depending on whether two LS belong to the same graphene sublattice or not. Prompted by these findings, we explored the role of the carrier-impurity exchange interaction in formation of magnetic phase states in graphene with vacancies and modification in graphene-based composite structures. Analysis of free energy F shows the antiferromagnetic (AF) ordering with partial compensation of the magnetizations M_A and M_B in two graphene sublattices. The difference M_A-M_B is caused by difference of the number of LS randomly distributed over the sublattices A and B. This effect of weak ferromagnetism becomes significant in multi-domain structure, provided a mean domain size is around 2 μm; it can explain the available experimental results. The proximity to ferromagnetic dielectric layers in a sandwich configuration results in an indirect magnetic interaction that can be expressed in terms of exchange bias field. The latter strongly depends on vacancy concentration x and even can reverse the direction of exchange bias field with x increasing. At the temperature of AF ordering the minimum of F corresponds to a tilt of M_A and M_B and even a collapse of the AF vector.

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