

Magnetism in phosphorene and AFM to FM switching by electric field

Arqum Hashmi* and Jisang Hong

Department of Physics, Pukyong National University, Busan 608-737, Korea.

Correspondence and requests for materials should be addressed to J.H. (hongj@pknu.ac.kr)

We explored the possibility of long range magnetic ordering in two-dimensional porous phosphorene (PP) layer by means of Ab-initio calculations. The self-passivated pore geometry showed a non-magnetic state while the pore geometry with dangling bond at two zigzag edges with the distance of 7.7 Å preferred an anti-ferromagnetic ordering (AFM). Pore to pore magnetic interaction with the distance of 13.5 Å between two pores was found to be remarkably long ranged and this emerges from the interactions between the magnetic tails of the edge states in the armchair direction. The AFM state was persisted by the oxidation of the edge. Interestingly, the long range AFM ordering changed to long range ferromagnetic (FM) ordering by external electric field. The results are noteworthy in the interplay between electric field and electronic spin degree of freedom in phosphorene studies and may also open a promising way to explore phosphorene based spintronics devices.

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and future planning (2016R1A2B4006406)