新学術領域「コンピューティクスによる物質デザイン：複合相関と非平衡ダイナミクス」
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グラフェン端原子配列が創出するスピン物性

Spin-related phenomena derived from graphene edges

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Although a variety of interesting phenomena has been experimentally reported in graphenes, mostly none has experimentally reported edge-related phenomena, because lithographic fabrication of graphene edges easily introduces defects and disorder. Basically, there are two kinds of atomic structures in graphene edges; arm chair and zigzag. Theoretically, arm chair edge gives band gap opening, while zigzag edge yields a flat energy band, resulting in electron localization and polarization.

Here, we have developed two non-lithographic methods for graphene edges; (1) graphene nanoribbons (GNRs) derived from unzipping of carbon nanotubes with annealing and (2) grahene nanopore arrays (GNPAs) fabricated using porous alumina template. We have found that in the former, the low-defect GNRs with arm chair edges can have band gaps 7-times greater than large-defect GNRs [1] and also that in the latter, the GNPAs with zigzag edges exhibit large-amplitude ferromagnetism [2] and anomalous magnetoresistance oscillations [3]. In the poster, we present the latter case related to zigzag-edge GNPAs. The zigzag-GNPAs must open a door to carbon-based spin physics and spintronics.

[1] T.Shimizu, J.Haruyama et al., *Nature Nanotech.***6**, 45 (2011)
[2] K. Tada, J. Haruyama et al., *Phys.Rev.Lett.* **107**, 217203 (2011)
[3] T. Shimizu, J. Haruyama et al., *Appl.Phys.Lett.* **100**, 023104 (2012)