Strain-Induced Half-Metallic States in Graphene: Application of Generalized Bloch Theorem

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Realization of half-metallicity in low dimensional materials is a fundamental challenge for nano spintronics, which is a critical component for next-generation information technology. Using the method of generalized Bloch theorem, we show that an in-plane bending can induce inhomogeneous strains, which in turn lead to spin-splitting in zigzag graphene nanoribbons and results in the highly desired half-metallic state. Unlike the previously proposed scheme that requires unrealistic strong external electric fields, the obtained half-metallicity with sizeable half-metallic gap and high energetic stability of magnetic order of edge states requires only relatively low-level strain in the in-plane bending. Given the superior structural flexibility of graphene and the recent experimental advances in controllable synthesis of graphene nanoribbons, our design provides a hitherto more practical approach to the realization of half-metallicity in low dimensional systems.