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Recovering edge states of graphene nanoislands on Ir(111) by silicon intercalations

It has been predicted by theory that free-standing graphene nanoribbons with zigzag edges have spin-polarized edge states with a promise for applications [1]. However, it has been widely reported that graphene nanoislands (GNIs) on metal substrates have no states that are localized at zigzag edges because of interaction with substrate electrons. Here, we demonstrate that edge states of GNIs with zigzag edges on Ir(111) can be recovered by intercalating a layer of Si atoms between GNIs and the Ir substrate. Using scanning tunneling microscopy and spectroscopy, in combination with density functional theory calculations, we show that GNIs are effectively decoupled from the Ir substrate by the intercalated Si layer, leading to the recovery of edge states that were originally suppressed by graphene-substrate interaction. We also find that edge states gradually shift to the Fermi level with increasing lateral sizes of the GNIs. In addition, theoretical calculations show that edge states of some irregular GNIs are spin-polarized, which suggests an avenue for construction of graphene-based spintronic devices.
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References

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Figures

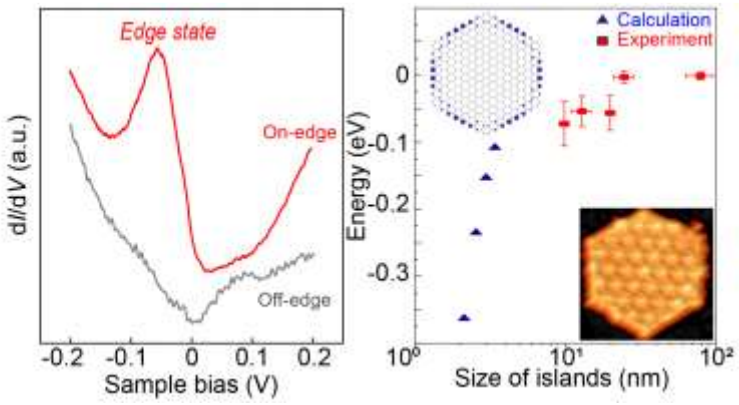

Figure 1: Appearance of edge states on the zigzag edge of GNI after Si intercalation. Right panel: The energy of the edge states versus lateral size of GNIs for both theoretical and experimental results