Probing the magnetism of topological end-states in 5-armchair graphene nanoribbons

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We extensively characterize the electronic structure of ultra-narrow graphene nanoribbons (GNRs) with armchair edges and zig-zag termini that have 5 carbon atoms across their width (5-AGNRs), as synthesised on Au(111), by means of Scanning Tunnelling Microscopy and Spectroscopy (STM/STS) experiments and Density Functional Theory (DFT) and tight-binding calculations. STM/STS measurements on the ribbons, recorded on both the metallic substrate and a decoupling NaCl layer, show well-defined dispersive bands and in-gap states. In combination with theoretical calculations, we show how these in-gap states are topological in nature and localised at the zig-zag termini of the nanoribbons. Besides rationalising the driving force behind the topological class selection of 5-AGNRs, we also uncover the length-dependent behaviour of these end states which transition from singly occupied spin-split states to a closed-shell form as the ribbons become shorter. Finally, we demonstrate the magnetic character of the end states via transport experiments in a model two-terminal device structure in which the ribbons are suspended between the scanning probe and the substrate that both act as leads.

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