Synthesis of radical spins in Kagome graphene

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Flat bands in Kagome graphene might host strong electron correlations and frustrated magnetism upon electronic doping [1]. However, the porous nature of Kagome graphene opens a semiconducting gap due to quantum confinement, preventing its fine-tuning by electrostatic gates. We induce zero-energy states into a semiconducting Kagome graphene by inserting π-radicals at selected locations [2]. We utilize the on-surface reaction of tribromotrioxoazatriangulene molecules to synthesize carbonyl-functionalized Kagome graphene on Au(111), thereafter modified in situ by exposure to atomic hydrogen. Atomic force microscopy and tunneling spectroscopy unveil the stepwise chemical transformation of the carbonyl groups into radicals, which creates local magnetic defects of spin state S = 1/2 and zero-energy states as confirmed by density functional theory.

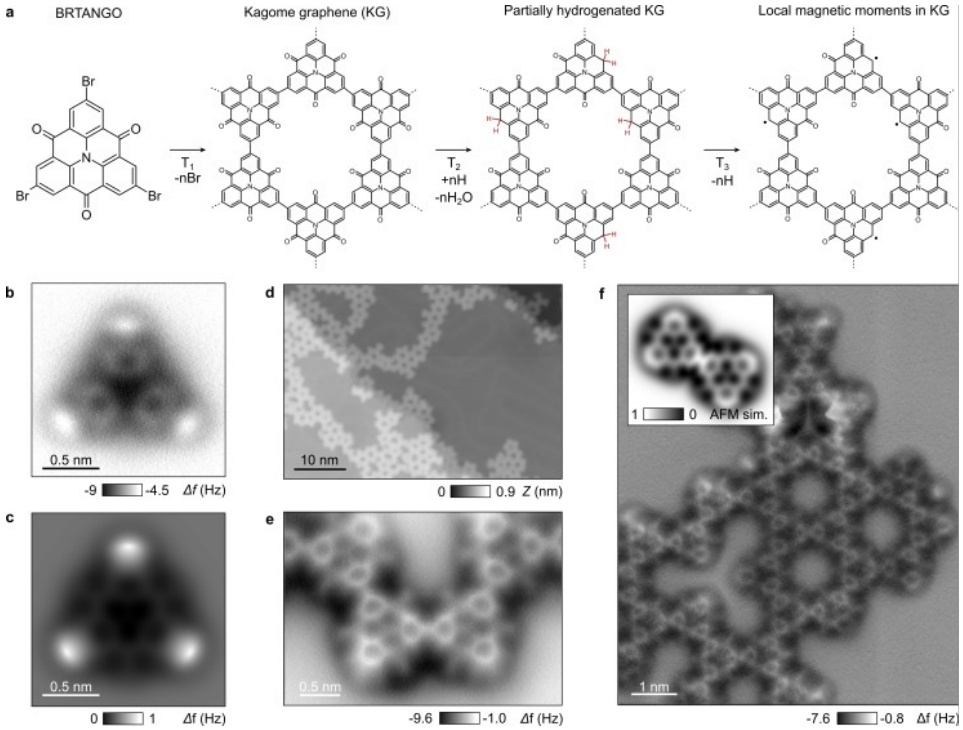

Figure 1. (a) Hierarchical synthesis of radical spins in carbonyl-functionalized Kagome graphene by an on-surface reaction. (b) AFM image with a CO-terminated tip of the isolated BRTANGO precursor. (c) Corresponding AFM image simulation. (d) STM image of the Kagome graphene after annealing the substrate at 450 K. (e–f) AFM image of the chemical structure of carbonyl-functionalized Kagome graphene, revealing the covalent coupling between azatriangulene monomers.

Reference

[1] R. Pawlak et al. Angewandte Chem. Int Ed. 60 8370-8375 (2020)

[2] R. Pawlak, et al. ACS Nano. **19**, 4798-4777 (2025)