Collective Magnetism of Spin Coronoid via On-Surface Synthesis

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Polyradicals obtained from open-shell coronoids hold promise for applications in spintronics and quantum technologies owing to the strong interactions between spins in fully-fused cyclic systems. Coronoid synthesis is long considered difficult due to the cyclization of nanographene. It becomes an immense challenge to synthesize open-shell coronoids, since radicals only appear when the macrocycle size exceeds a critical value. Here, we took inspiration from recent progress in the synthesis of open-shell nanographenes and present an open-shell coronoid with six radicals achieved through on-surface synthesis.[1-3] Integrating the triangular zigzag structure into the coronoid framework could lead to additional Clar's sextet rings, transforming the coronoid from a closed-shell to an open-shell structure with polyradical characters. The chemical and electronic structures of the coronoid are precisely characterized through a combination of scanning tunneling microscopy (STM) and non-contact atomic force microscopy (nc-AFM) experiments. This spin coronoid displays a collective spin state arising from both the nearest and next-nearest neighbor exchange interaction of six unpaired π -electrons along the conjugation pathways. The characterization of the spin excitation from the ground state to the excited states was carried out using inelastic electron tunneling spectroscopy. Additionally, we show that the spin coronoid can be utilized as a nanoscale platform to achieve short antiferromagnetic spin-1/2 Heisenberg chains through tip manipulation. Our findings present a design strategy for creating coronoids with polyradicals, which could provide inspiration for fabrication of open-shell coronoid or cyclic spintronic systems.

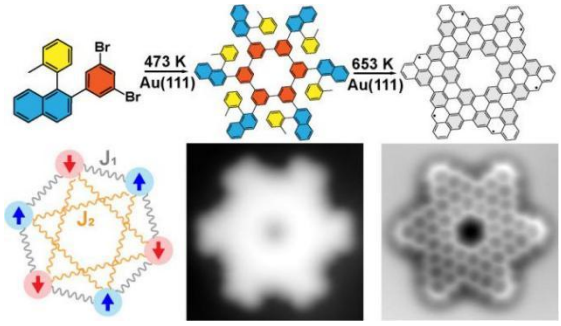

Figure 1. Chemical structure and spin excitations of open-shell coronoid.

Reference

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