chem2Dmat
August 31 - September 03, 2021 ● Bologna, Italy
European Conference on Chemistry of Two-Dimensional Materials

Inducing carbon magnetism in nanographenes

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Magnetism is historically associated to d- and f-block elements of the periodic table, which form the basis for modern information storage technologies. However, recent advances on the bottom-up synthesis of low-dimensional materials revealed the emergence of non-trivial magnetic states in all-carbon compounds. The low spin-orbit and hyperfine couplings in carbon, along with the possibility of electric-field control of magnetism, provides unique opportunities in emerging technologies such as quantum computation. The electronic structure of nanographenes can be selectively controlled through variation in size, shape and edge structure, allowing to experimentally realize new quantum properties, including magnetism. In this contribution, we investigate the on-surface synthesis of z-shaped nanographenes belonging to the zethrene family. Single molecule scanning probe measurements reveal the transition from a closed-shell to an open-shell singlet ground state with increasing zethrene length. In the longest analogue, singlet to triplet spin excitation are detected via inelastic electron tunneling spectroscopy, unveiling a magnetic exchange coupling of 50 meV. These results open new perspectives for the realization of organic magnetic devices operating at practical temperatures.

References

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Figure 1

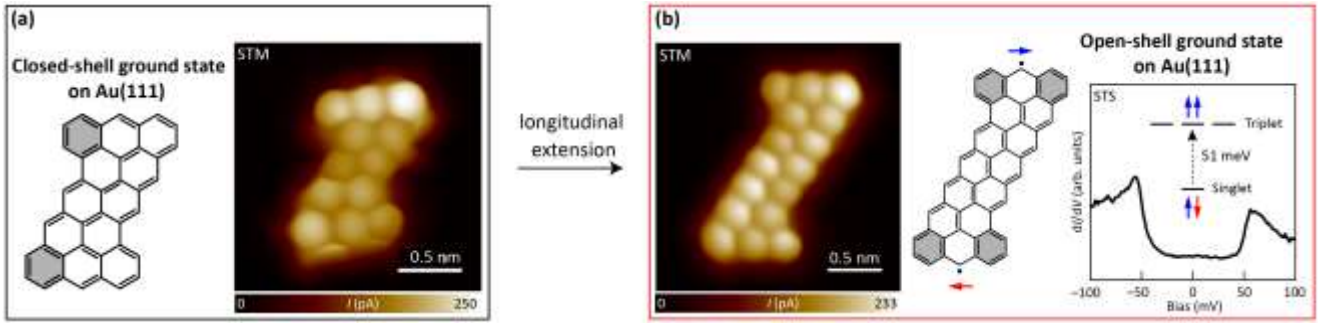

Figure 1: (a)(b) Bond-resolved STM imaging shows the on-surface synthesis of two z-shaped nanographenes with increasing length. (b) In the longest analogue, high resolution tunneling spectroscopy reveals inelastic singlet-triplet spin excitations.