Graphene nanoarchitectures: from fundamentals to applications

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On-surface reactions, via programmed interactions of molecular building blocks, has recently emerged as a promising route to synthesize atomically precise materials from the 'bottom-up'. This approach ensures exquisite atomic-scale control of the structural and chemical functionalization, allowing to design a vast number of carbon-based nanoarchitectures not available by traditional solution chemistry nor with the 'top-down' methodologies.

In this talk, I will discuss our recent results to synthetize atomically precise nanoporous graphene [1], graphene nanoribbons and their chemical functionalization and how to organize them into atomically-sharp heterojunctions [2-4], and the molecular bridge engineering (fig.1) for tuning quantum electronic transport and anisotropy in nanoporous graphene [5].

At the end of the day, this talk will demonstrate the full path to synthetize a semiconducting graphene material with a bandgap similar to that of silicon, its atomic-scale characterization, and its implementation in a three-terminal electronic device, as well, its implementation as atomically-thin membrane for gas filtration and integrated into photonic biosensors.

References

[1] Moreno et al. Science 360, 199–203 (2018)
[2] Moreno et al. Chem. Comm. 54, 9402–9405 (2018)
[3] Moreno et al., Chem. Mat. 31(4), 331-341 (2019)
[4] Tenorio, Moreno et al. Adv. Mat. 34, 20-2110099 (2022)
[5] Moreno et al., J. Am. Chem. Soc (to be accepted, 2023)

Figures

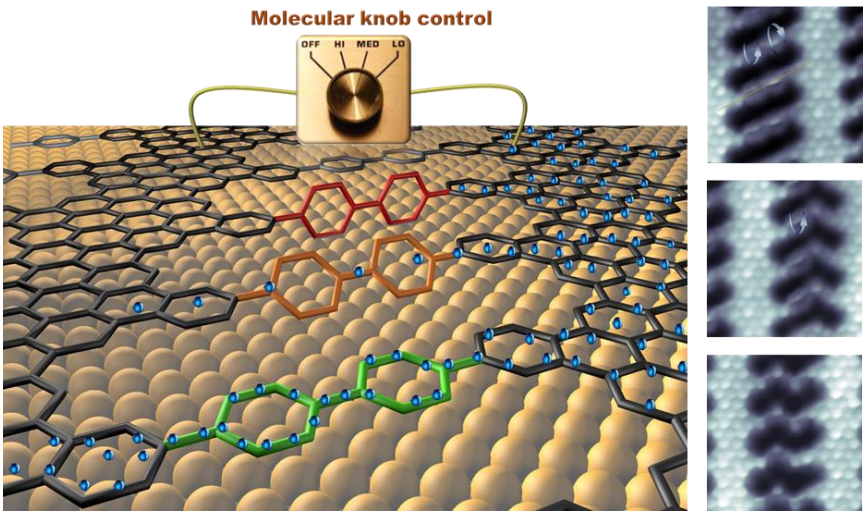

Figure 1: Concept sketch of molecular bridge engineering for tuning quantum electronic transport and anisotropy in nanoporous graphene, and (right) STM images displaying its experimental realization.