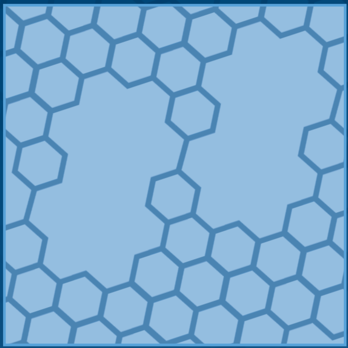


Nanoporous Graphene

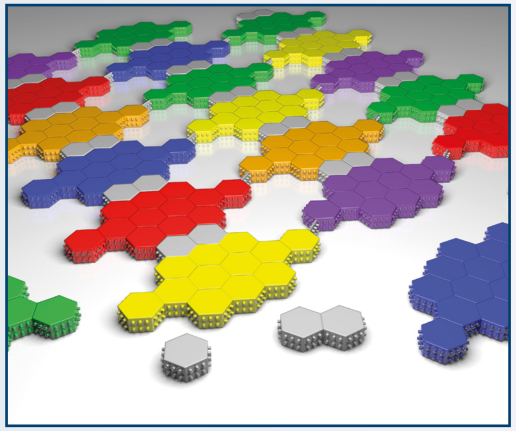
Presenting a new holey graphene grown with identical pores in precise positions

Spanish researchers have devised an inexpensive way to grow a new kind of graphene, one with uniformly arranged pores of the same size and shape. No easy feat. Now imagine that this same method allows the geometry and chemistry of the pores to be configured at the level of individual atoms.

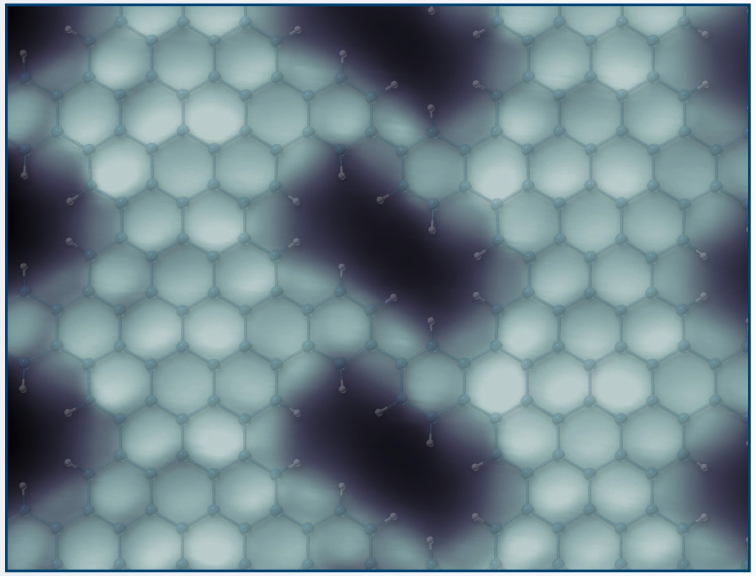
The result is a semiconducting graphene material with a bandgap similar to that of silicon and holes specifically designed to let through certain target molecules and block others. Potential applications include in electronics, photonics, and highly selective molecular filtration and sensing systems.

ICN2
Institut Català de Nanociència i Nanotecnologia
EXCELENCIA SEVERO OCHOA
CiQUS
Center for Research on Biological Chemistry and Molecular Materials

Holey graphene by Lego chemistry



Researchers have devised a flexible method for the bottom-up synthesis of nanoporous graphene. Grown to order from molecular building blocks, the result is a range of versatile 2D membranes with high-density periodic arrays of subnanometer pores fabricated with atomic precision and full control over its chemical functionalisation. It is a totally new material which adds **tunable permeability** and **semiconductivity** to graphene's already long list of properties, opening it up to new multifunctional applications that require pores, a bandgap, or both.



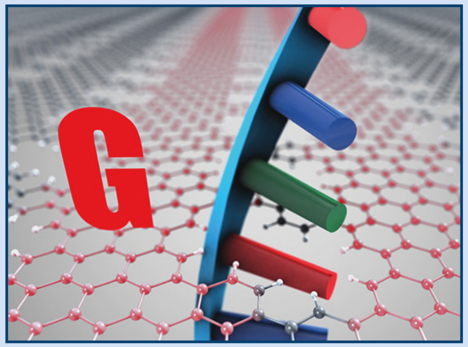
Applications in (opto)electronics

One of the most significant attributes of this nanoporous graphene is the energy bandgap induced by the unprecedented precision of the spacing between pores. This new semiconducting graphene-based material exhibits a bandgap similar to that of silicon, where standard graphene has none. Potential applications include as field-effect transistors (FET) for flexible transparent electronics, and near infra-red and visible optoelectronics based on gate-modulated plasmonics.

Membrane applications

The mechanical properties of this new material, resulting from the atomic control over the exact size and shape of the pores, point to its use as a highly selective molecular sieve. This selectivity can be further enhanced through the careful design of the initial building block, allowing a high degree of chemical functionalisation. It also offers the advantage of being one-atom thick, affording high throughput at low pressures. The resulting membranes can be used for water desalination, pollutant treatment, gas separation and haemodialysis.

Multifunctional applications



More unique applications for nanoporous graphene emerge from the combination of these enhanced structural and (opto) electrical properties. In an example of one plus one giving more than two, it can find multifunctional applications in gate-controlled sieving and sensing (FET sensors), in-operando electrical monitoring and gate-controlled electrical DNA sequencing.

Institut Català de Nanociència i Nanotecnologia

Center for Research on Biological Chemistry and Molecular Materials

Catalan Institute of Nanoscience and Nanotechnology (ICN2)

Campus de la UAB
08193 Bellaterra
Barcelona, Spain

Knowledge and Technology Transfer Department
+34 937 372 649
technology.transfer@icn2.cat

Atomic Manipulation and Spectroscopy Group
www.icn2.cat

This material is patent pending.

Related article:

C. Moreno, M. Vilas-Varela, B. Kretz, A. Garcia-Lekue, M. V. Costache, M. Paradinas, M. Panighel, G. Ceballos, S. O. Valenzuela, D. Peña, and A. Mugarza. ***Bottom-up synthesis of multifunctional nanoporous graphene***. **Science**, 360 - 6385 (2018)

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Barcelona Institute of Science and Technology