their study, Martens and colleagues[1] provide the first analytical description that predicts the existence of such spiral-wave chimeras. Therefore, as unusual as these spirals may seem, they cannot be attributed to artefacts of the numerical simulations. Admittedly, Martens *et al.* obtained their results for a relatively simple system under analytically treatable conditions. This is, on the other hand, also a reason why they are important: they reveal what may well be just the tip of the iceberg.

Open problems abound. The characterization of the basins of attraction associated with chimera states — and, for that matter, the possible attractors — remains widely untouched. For instance, how can one determine whether a given set of initial conditions corresponds to a uniform as opposed to a chimera state? The characterization of the stability of these states as functions of the system parameters also remains fairly under-explored. It is possible that for some parameter choices several coherent formations will coexist or new forms of non-stationary chimeras will emerge. Also, experimental observation of such states in natural systems, neuronal or not, would be particularly informative. Indeed, although chimera states do not need extra structure to exist, they are not destroyed by small disorder either[7]. This strengthens the prospects for observing them in real systems. More importantly, additional structure can lead to a myriad of other possible behaviours, including quasiperiodic chimeras[8] and chimeras that 'breathe', in the sense that coherence in the desynchronized population cycles up and down[4].

Future research might benefit from two other surprising recent discoveries. First, for several systems of infinitely many non-identical phase oscillators, it has been shown that a wide class of solutions can be reduced not approximately, but exactly to a system described by just a handful of degrees of freedom[9]. This has already inspired recent research on chimera states for non-identical oscillators[7]. Second, in complex networks of identical oscillators, it has been demonstrated that the stability of globally synchronous states depends sensitively on the structure of the network[10]. It is therefore natural to ask about the nature of (partially synchronous) chimera states in such complex networks. If previous experience is anything to go by, one can expect that this research will lead to incongruous yet fascinating new surprises about the dynamics of complex systems. ❒

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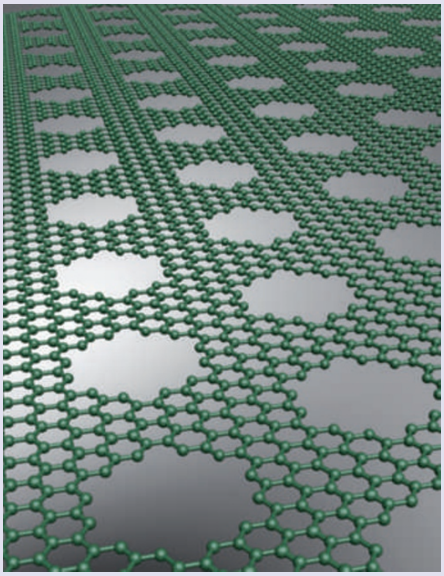
GRAPHENE

Switched on

Despite its amazing electrical properties, the fact that graphene is a semimetal — there is no energy gap between its conduction and valence bands — can be a bit of a handicap. The small bandgap in semiconductors such as silicon (small relative to insulators that is) is essential for the operation of transistors and diodes. Jingwei Bai and co-workers have now shown that shaping a graphene layer into a mesh can open up a bandgap large enough for electrical switching (*Nature Nanotech.* **5,** 190–194; 2010).

A bandgap has previously been created in graphene by tearing it into ribbons of less than 10 nm in width. The problem with this approach is that it is not easily scalable to produce arrays of devices. Bai *et al.* constructed their devices using techniques borrowed from, and therefore compatible with, large-scale semiconductor fabrication. A layer of graphene was coated with protective silica upon which lay a polystyrene film with a hexagonal array of cylindrical pores. Bombarding this with reactive ions transferred the pattern into the silica. A mesh was then created by placing the sample into an oxygen plasma to copy the pattern to the graphene.



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The team constructed a transistor by placing the graphene mesh onto a silicon substrate and attaching two electrical contacts. A small current flowed through the device when a voltage was applied across the contacts. However, applying a voltage to the substrate 'turned on' the device and enabled a much larger flow, just like in a switch.

The space between the holes in the graphene mesh was crucial to the behaviour of this transistor. Research on graphene ribbons has shown that the bandgap increases with decreasing ribbon width. A similar trend would be expected in the mesh structure, which can be thought of as many ribbons in parallel. This is exactly what the team discovered: the ratio of the on-current to the off-current was 6 in the case of 15-nm-wide channels, but increased to 100 in a device in which the space was just 7 nm.

There are a number of effects that could open a bandgap in this way: localization of the electrons at the newly created edges in the graphene layer or effects owing to electron quantum confinement are just two examples. However, Bai *et al.* have left a full investigation of the exact origin of the bandgap for future work.

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