## News and Views

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# Materials science: Bend, fold and stretch

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It is tempting to view graphene as the material of choice for the next generation of electronic devices. The fact that it forms strong, bendable sheets — made from carbon atoms arranged in a honeycomb lattice — together with its remarkable electronic properties makes it a promising starting point for flexible electronic applications.

However, the high-performance electronic graphene devices reported so far are made from tiny, micrometre-sized pieces of graphene, obtained using a rather cumbersome method that involves peeling off layers from a larger graphite substrate. In a paper published online in *Nature*, Byung Lee Hong and his colleagues now describe an alternative and more versatile method to produce graphene films with excellent electronic properties and with large, centimetre-scale areas (K. S. Kim *et al*. Nature doi:10.1038/nature07719; 2009).

Although chemical-processing techniques already exist for producing large-area graphene material, the electronic properties of such materials have been disappointing. But Hong *et al*. have perfected an approach known as chemical-vapour deposition. In this technique, a gaseous mixture of hydrocarbons flows over heated nickel foils and breaks down into atomic carbon, which in turn rearranges into graphene. Rapid cooling of the substrate then ensures that films just a few layers thick are formed. These ultrathin films are optically transparent and have high electrical conductivity, similar to that of mechanically cleaved graphene.

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The main promise of Hong and colleagues' method lies in large-area applications, notably transparent, flexible electrodes such as that pictured. Hong *et al*. show that the graphene films can be radically bent and stretched without affecting their optical and electronic properties. And crucially, with this fabrication method the graphene can be easily transferred to other materials, because the underlying nickel can simply be etched away and the graphene film picked up and placed elsewhere. In addition, nanoscale patterns can be made in the graphene films by pre-patterning the nickel substrate with standard lithography techniques.

This combination of straightforward processing techniques and desirable properties increases the prospects of inexpensive, flexible and reliable electronic devices. Future applications, such as in photovoltaics, or as sensors and displays that are wearable or foldable, suddenly don't seem to require such a stretch of the imagination.