A design guide for future graphene chips

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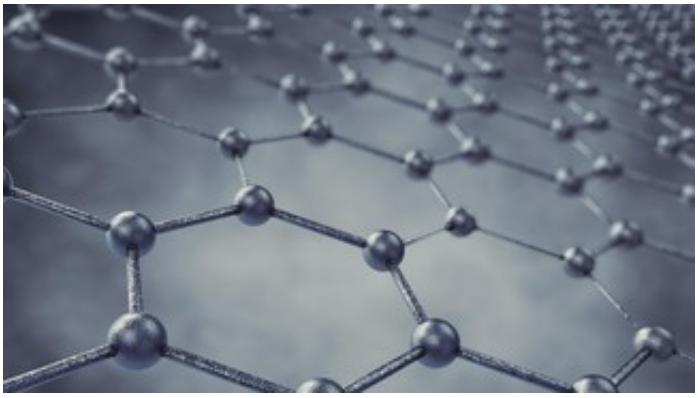

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Swiss scientists have come up with a "how-to manual" for making the most efficient optical graphene circuits possible. The procedure facilitates and accelerates technological development in this future field. The research has been published in the scientific journal "Nature Photonics."

Thanks to its amazing properties, graphene hold great promise as the basis for new chips that are faster, better-performing and more compact. For example, this material makes it possible to design systems that can either block electromagnetic radiation or allow it to pass, producing digital information analogous to the 1s and 0s of transistors. But up to now, it has been impossible to predict in advance these circuits' top potential efficiency. The two parameters that influence performance are the quality of the graphene, which depends on its atomic-scale structure,

and the design of the circuit, which includes the other materials in the circuit, its geometry, and so on.

Michele Tamagnone, a PhD student in professor Julien Perruisseau-Carrier's laboratory, has developed a new approach which allows the following conclusion: the maximum theoretical efficiency of the system is solely a function of the quality of the graphene. By playing with the design, it is possible to approach this ceiling, but there is no way it can be surpassed. The scientists have thus managed to develop a method for precisely determining which design is the most appropriate for a given quality of graphene.

This theoretical approach has enormous practical consequences. The researchers are effectively providing companies and researchers with a clear methodology to optimize their graphene circuits. Their results have been published in the journal *Nature Photonics*.

Going beyond the empirical approach: a manual for researchers

At the moment, since the possible combinations are infinite, scientists are proceeding via trial and error. The new method developed at EPFL gives them a concrete solution. "To attain the desired performance, you can determine which improvements in material quality are required. And without having to do any work on the design. The inverse is also true: with a given material, you can determine the ideal design to use. In other words, by dissociating the design part with the material part, the work of designers is greatly facilitated," explains Perruisseau-Carrier.

He adds that this information could be very valuable in both research and industry, and that the applicability of the tool isn't limited to graphene, but could also extend to a great number of other materials.

More information: "Fundamental limits and near-optimal design of graphene modulators and non-reciprocal devices." Michele Tamagnone, et al. *Nature Photonics* (2014). DOI: 10.1038/nphoton.2014.109 . Received 02 January 2014 Accepted 15 April 2014 Published online 18 May 2014

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