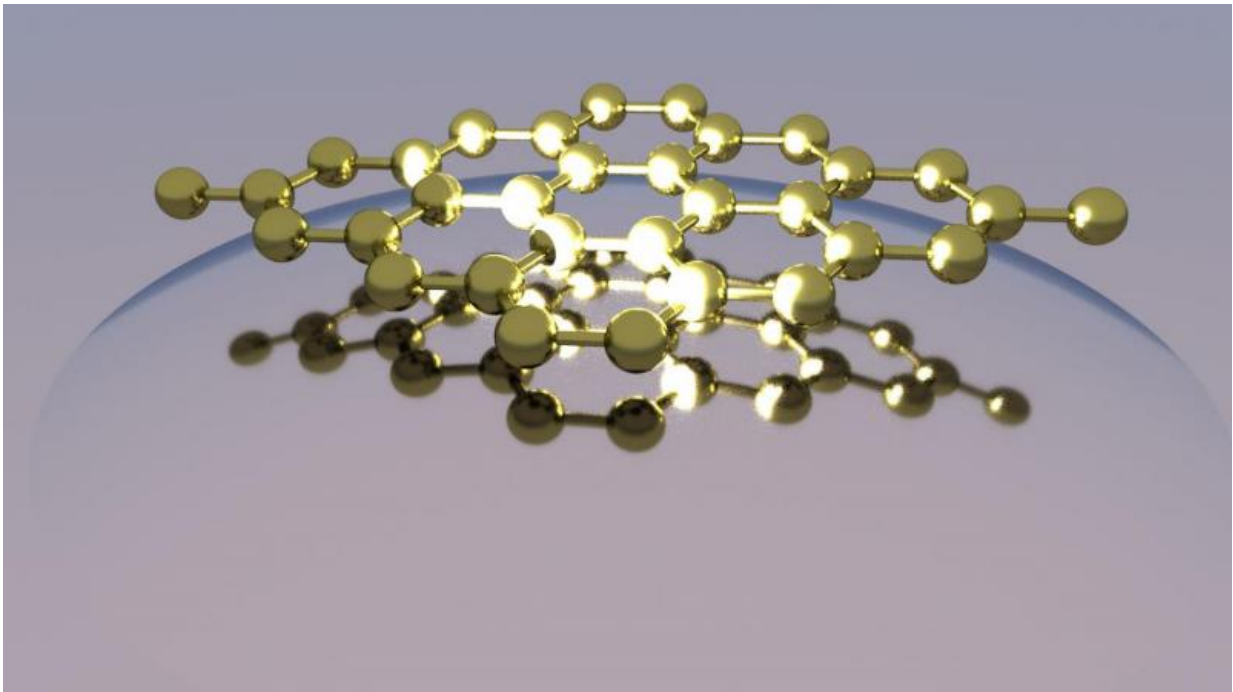


New theory could lead to new generation of energy friendly optoelectronics

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The transparency of a device at the 2D limit can be tuned using an electric bias, where different type of optical processes that simply define the way we see objects can be modify externally. This gives the control on properties that until very recently were not thought to be manipulated arbitrarily. Credit: Queen's University, Belfast

Researchers at Queen's University Belfast and ETH Zurich, Switzerland, have created a new theoretical framework which could help physicists

and device engineers design better optoelectronics, leading to less heat generation and power consumption in electronic devices which source, detect, and control light.

Speaking about the research, which enables scientists and engineers to quantify how transparent a 2D material is to an electrostatic field, Dr Elton Santos from the Atomistic Simulation Research Centre at Queen's, said: "In our paper we have developed a [theoretical framework](#) that predicts and quantifies the degree of 'transparency' up to the limit of one-atom-thick, 2D materials, to an [electrostatic field](#).

"Imagine we can change the transparency of a material just using an electric bias, e.g. get darker or brighter at will. What kind of implications would this have, for instance, in mobile phone technologies? This was the first question we asked ourselves. We realised that this would allow the microscopic control over the distribution of charged carriers in a bulk semiconductor (e.g. traditional Si microchips) in a nonlinear manner. This will help physicists and device engineers to design better quantum capacitors, an array of subatomic power storage components capable to keep high energy densities, for instance, in batteries, and vertical transistors, leading to next-generation optoelectronics with lower [power consumption](#) and dissipation of heat (cold devices), and better performance. In other words, smarter smart phones."

Explaining how the theory could have important implications for future work in the area, Dr Santos added: "Our current model simply considers an interface formed between a layer of 2D material and a bulk semiconductor. In principle, our approach can be readily extended to a stack of multiple 2D materials, or namely, van der Waals heterostructures recently fabricated. This will allow us to design and predict the behaviour of these cutting-edge devices in prior to actual fabrication, which will significantly facilitate developments for a variety

of applications. We will have an in silico search for the right combination of different 2D crystals while reducing the need for expensive lab work and test trials."

More information: Further information on the Atomistic Simulation Research Centre at Queen's is available online at titus.phy.qub.ac.uk/

Provided by Queen's University Belfast

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