Don't underestimate undulating graphene: Unique electronics made possible by wavy patterns that channel electrons

23 March 2022, by Mike Williams

A theory by Rice University researchers suggests growing graphene on a surface that undulates like an egg crate would stress it enough to create a minute electromagnetic field. The phenomenon could be useful for creating 2D electron optics or valleytronics devices. Credit: Henry Yu/Rice University

Their study appears in the American Chemical Society's *Nano Letters*.

They also promise a way to achieve a Hall effect — a voltage difference across the strongly conducting graphene — that could facilitate valleytronics applications that manipulate how electrons are trapped in "valleys" in an *electronic band structure*.

Valleytronics are related to spintronics, in which a device's memory bits are defined by an electron's quantum spin state. But in valleytronics, electrons have degrees of freedom in the multiple momentum states (or valleys) they occupy. These can also be read as bits.

This is all possible because graphene, while it may be one of the strongest known structures, is pliable enough as it adheres to a surface during chemical vapor deposition.

"Substrate sculpting imparts deformation, which in turn alterns the material electronic structure and changes its optical response or *electric conductivity*," said Yu, now a postdoctoral researcher at Lawrence Livermore National Laboratory. "For sharper substrate features beyond the pliability of the material, one can engineer defect placements in the materials, which creates even more drastic changes in material properties."

Yakobson compared the process to depositing a sheet of graphene on an egg crate. The bumps in the crate deform the graphene, stressing it in a way that creates an *electromagnetic field* even without electrical or magnetic input.

"The endless designs of substrate shapes allow for countless optical devices that can be created, making possible 2-D electron optics," Yakobson
said. "This technology is a precise and efficient way of transmitting material carriers in 2-D electronic devices, compared to traditional methods."


Provided by Rice University


*This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.*