

The comeback kid—black phosphorus and its new potential

July 5 2017

When it was discovered over a century ago, black phosphorus was considered relatively useless. Over the past five years, however, the engineers and chemists have become intrigued by the material for its potential as an ultra-thin semiconductor, possibly ushering in a new age of flexible and smaller electronics. Now, one group reports in *Nano Letters* that some commonly held assumptions about black phosphorus are incorrect and that the material is exceptionally tunable.

Black phosphorus is emerging as a promising 2D semiconductor material. Semiconductors have a narrow [band gap](#) that allows them to conduct electricity. Black phosphorus can absorb and emit light in the visible through infrared spectrum, which is useful for sensors, communications and other applications. But when black phosphorus is put into devices, it breaks down rapidly in ambient conditions. To combat this degradation, researchers have encapsulated black phosphorus with passive insulators, assuming that this containment did not affect its properties; however, Steven Louie, Diana Qiu and Felipe da Jornada wanted to determine whether this was theoretically true.

The researchers performed calculations on one- to four-layer versions of black phosphorus, both with and without encapsulation, to examine its properties in a more systematic way. Some black phosphorus characteristics, such as the onset of optical absorption, were nearly unaffected in the calculations. But others, such as the band gap and shape of the [optical absorption](#) changed dramatically, so the properties of the material become qualitatively different. These findings indicate

that the properties of [black phosphorus](#) could be tuned by enclosing it in the right way, opening many new possibilities for its use.

More information: "Environmental Screening Effects in 2D Materials: Renormalization of the Bandgap, Electronic Structure, and Optical Spectra of Few-layer Black Phosphorus" *Nano Letters* (2017). pubs.acs.org/doi/abs/10.1021/acs.nanolett.7b01365

Provided by American Chemical Society

Citation: The comeback kid—black phosphorus and its new potential (2017, July 5) retrieved 25 April 2024 from <https://phys.org/news/2017-07-comeback-kidblack-phosphorus-potential.html>

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.