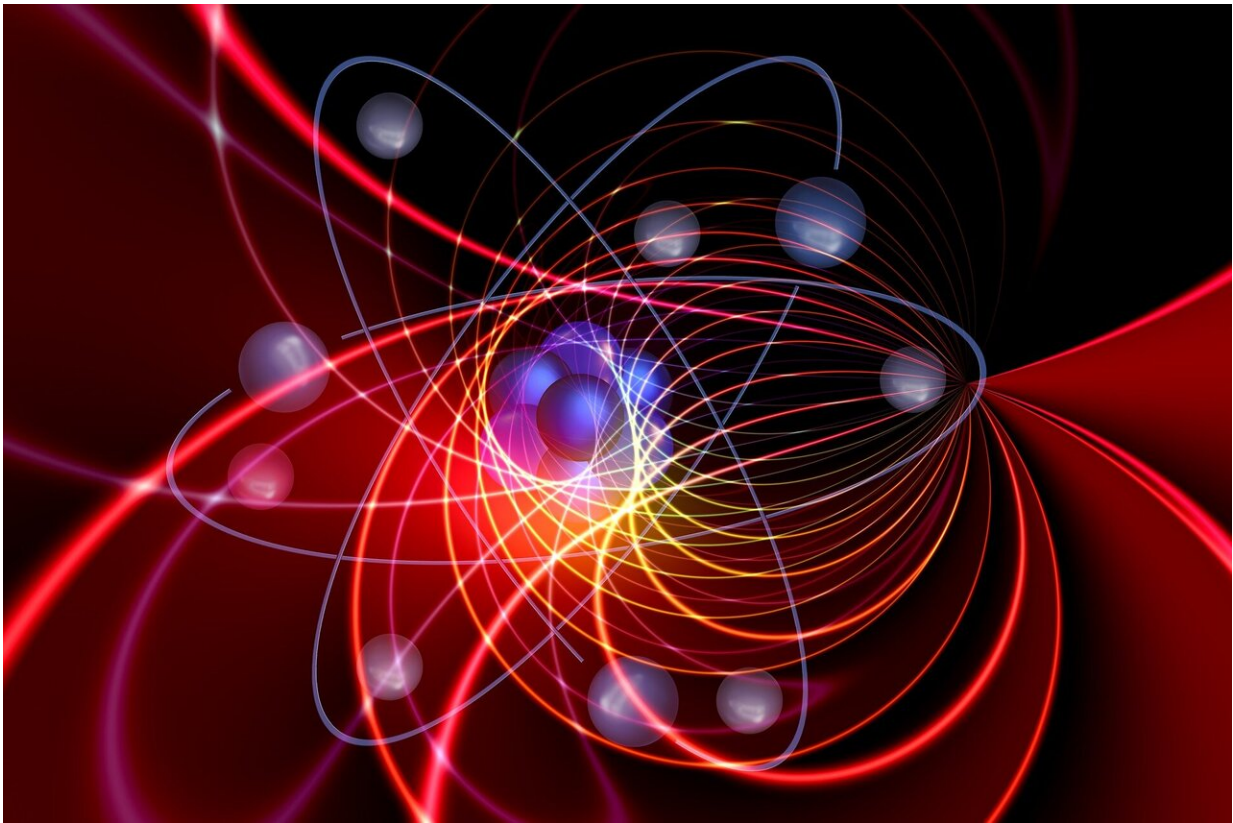


A promising breakthrough for a better design of electronic materials

March 16 2021



Credit: Pixabay/CC0 Public Domain

Finding the best materials for tomorrow's electronics is the goal of Professor Emanuele Orgiu of the Institut national de la recherche scientifique (INRS). Among the materials in which Professor Orgiu is

interested are some made of molecules that can conduct electricity. He has demonstrated the role played by molecular vibrations on electron conductivity in crystals of such materials. This findings have applications in electronics, energy and information storage. The study, conducted in collaboration with a team from the INRS and the University of Strasbourg (France), was published in *Advanced Materials* .

The scientists were interested in observing the relationship between the structure of materials and their ability to conduct electricity. To this end, they measured the speed of propagation of electrons in crystals formed by these molecules. In their study, the authors compared two perylene diimide derivatives, which are semiconducting molecules of interest because of their use on flexible devices, smart clothes or foldable electronics. The two [compounds](#) encompassed within the study have similar chemical structure but featured very different conduction properties.

The research group was able to establish that the different [molecular vibrations](#) composing the material were responsible for the different electrical behavior observed in devices. "For a current to flow through a material, electrons must 'hop' from one molecule to the neighboring one. Depending on the level of movement of the molecules, which depends on the amplitude and energy of the related vibrations (called phonons), the electrons can move more or less easily through the material," explains Professor Orgiu, whose research team is the first to demonstrate which vibrations have the greatest influence on electron flows.

An Ad Hoc Molecular Design to Make Electrons Travel Faster

This breakthrough paves the way for the development of even more efficient materials for electronics. "By knowing what type of vibrations

allows charges to move more easily, we are providing chemists with a formula for synthesizing the right materials, rather than going in blindly," explains Marc-Antoine Stoeckel. This research opens up new applications that could not be envisaged with silicon, the most widely used material in electronics, including computers.

Professor Orgiu collaborated with INRS Professor Luca Razzari to measure the vibrations of the [molecules](#). The two researchers are now working on a new spectroscopic technique that would enable them to visualize the vibrations when electrons are present. This will allow them to see if charges affect molecular vibrations.

More information: Marc-Antoine Stoeckel et al, Analysis of External and Internal Disorder to Understand Band-Like Transport in n-Type Organic Semiconductors, *Advanced Materials* (2021). [DOI: 10.1002/adma.202007870](#)

Provided by Institut national de la recherche scientifique - INRS

Citation: A promising breakthrough for a better design of electronic materials (2021, March 16) retrieved 18 April 2024 from <https://phys.org/news/2021-03-breakthrough-electronic-materials.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.