Better studying superconductivity in single-layer graphene

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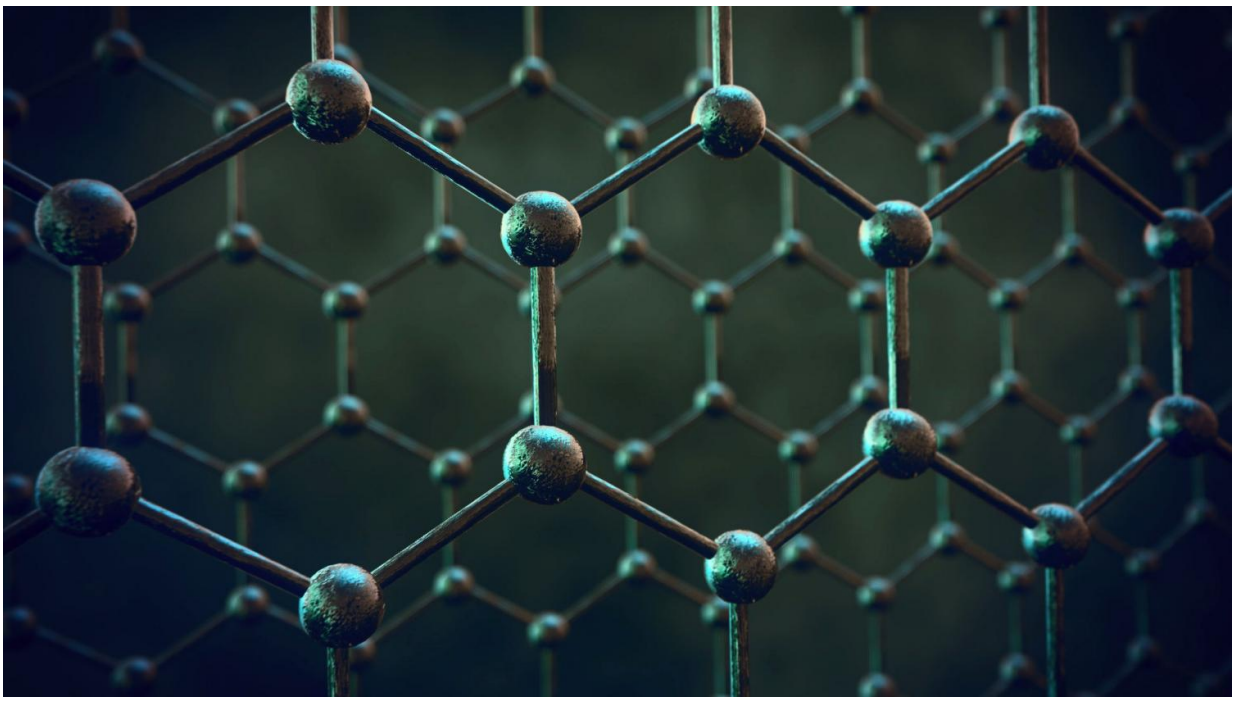

This visualisation shows layers of graphene used for membranes. Credit: University of Manchester

Made up of 2-D sheets of carbon atoms arranged in honeycomb lattices, graphene has been intensively studied in recent years. As well as the material's diverse structural properties, physicists have paid particular attention to the intriguing dynamics of the charge carriers its many variants can contain. The mathematical techniques used to study these

physical processes have proved useful so far, but they have had limited success in explaining graphene's 'critical temperature' of superconductivity, below which its electrical resistance drops to zero. In a new study published in *The European Physical Journal B*, Jacques Tempere and colleagues at the University of Antwerp in Belgium demonstrate that an existing technique is better suited for probing superconductivity in pure, single-layer graphene than previously thought.

The team's insights could allow physicists to understand more about the widely varied properties of graphene; potentially aiding the development of new technologies. Typically, the approach they used in the study is used to calculate critical temperatures in conventional superconductors. In this case, however, it was more accurate than current techniques in explaining how critical temperatures are suppressed with lower densities of charge carriers, as seen in pure, single-layer graphene. In addition, it proved more effective in modelling the conditions which give rise to interacting pairs of electrons named "Cooper pairs," which strongly influence the electrical properties of the material.

Tempere's team made their calculations using the 'dielectric function method' (DFM), which accounts for the transfer of heat and mass within materials when calculating critical temperatures. Having demonstrated the advantages of the technique, they now suggest that it could prove useful for future studies aiming to boost and probe for superconductivity in single and bilayer graphene. As graphene research continues to be one of the most diverse, fast-paced fields in materials physics, the use of DFM could better equip researchers to utilise it for ever more advanced technological applications.

More information: Dietrich Elst et al, Plasmonic Cooper pairing in single layer graphene, *The European Physical Journal B* (2019). DOI: 10.1140/epjb/e2019-100427-0

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