Defining the graphene family tree

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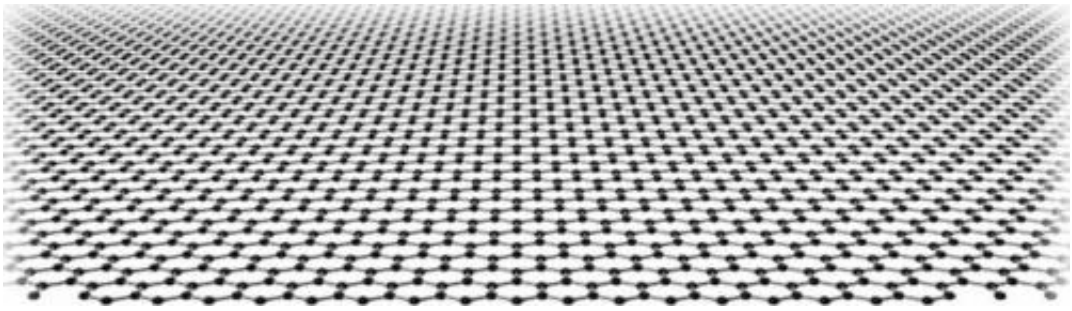

Credit: University of Manchester

There has been an intense research interest in all two-dimensional (2D) forms of carbon since Geim and Novoselov's discovery of graphene in 2004. But as the number of such publications rise, so does the level of inconsistency in naming the material of interest. The isolated, single-atom-thick sheet universally referred to as "graphene" may have a clear definition, but when referring to related 2D sheet-like or flake-like carbon forms, many authors have simply defined their own terms to describe their product.

This has led to confusion within the literature, where terms are multiply-defined, or incorrectly used. The Editorial Board of Carbon has therefore published the first recommended nomenclature for 2D carbon forms.

The editorial team spent eight months working on setting the definitions.

They believe that agreeing on a rational scientific nomenclature could enable more rapid development in the field, and with a "higher degree of common understanding". Editor-in-Chief of Carbon, Professor Robert Hurt (Institute for Molecular and Nanoscale Innovation, School of Engineering, Brown University, USA) succinctly summarizes the need for this work with the phrase: "Precise names promote precise ideas."

A series of basic guiding principles to define the terms was used in the study, where possible making use of established definitions, and clarifying rather than replacing existing terms. The study also recognizes that researchers will want to continue using the word "graphene" in publications, and so have recommended "graphene materials" as the overarching phrase to describe 2D carbons. In this way, the publication offers itself as a practical guide for naming such materials, for carbon scientists in all fields and at all stages in their careers.

One proposal is that all definitions of graphene materials should go beyond crystallography, and should include morphological descriptors for shape and size - namely the thickness (layer number), lateral dimensions and in-plane shape of these carbon layers.

To move graphene materials beyond the early discovery phase and into applications, internationally-recognized definitions of each carbon form will be needed. In the 1990s, the lack of agreed definitions for nanofibers, nanorods and nanotubes led to several International Standards on the topic, which, when published, brought consistency to the field.

"This study is a great way to open the discussion on graphene terminology, and welcomes any formal standardization efforts for 2D carbons in the future," concludes Prof Hurt c "We would be delighted if the community at large saw sufficient value in the recommendations to use them more broadly."

More information: "All in the graphene family - A recommended nomenclature for two-dimensional carbon materials," Alberto Bianco, Hui-Ming Cheng, Toshiaki Enoki, Yury Gogotsi, Robert H. Hurt, Nikhil Koratkar, Takashi Kyotani, Marc Monthioux, Chong Rae Park, Juan M.D. Tascon and Jin Zhang, *Carbon*, Volume 65, December 2013, Pages 1-6 (2013)

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