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Spectroscopic metrics for determining size and thickness of liquid exfoliated nanosheets in dispersion

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Over the last few years, the study of 2-dimensional (2D) nanomaterials has become one of the most important areas of both materials science and nanotechnology. While this work originally focused on graphene, the palette of 2D materials currently under study includes transition metal dichalcogenides (TMDs) such as MoS_2 and WSe_2, layered transition metal oxides such as MoO_3 and a host of other interesting structures such as GaS or phosphorene. Particularly useful is the diversity of 2D materials: depending on the combination of elements and their arrangement, they can be metals, semiconductors, insulators or superconductors.

Liquid-phase exfoliation has proven to be a powerful technique to obtain large quantities of exfoliated 2D materials in dispersion, ultimately making the materials processable. This method involves the sonication of layered crystals in certain solvents or solutions of surfactants or polymers. Even though being extremely versatile and useful, it has notable disadvantages such as polydispersity of materials produced.

We have performed detailed spectroscopic and microscopic analysis on size-selected dispersions of exfoliated MoS_2 nanosheets. This has led to the development of an *in situ* technique which allows nanosheet concentration, lateral size and thickness to be obtained simultaneously from an optical extinction/absorption spectrum. The combination of concentration-control, size-selection and measurement facilitates the preparation of dispersions with pre-determined properties. For example, monolayer-enriched dispersions can be produced, allowing the first measurement of direct-gap luminescence in liquid suspensions. In subsequent studies, similar metrics for other liquid-exfoliated nanosheets such as graphene, GaS and $MoTe_2$ is developed.

Biography

Claudia Backes has received her PhD with Honors in 2011 from the University of Erlangen, Germany. From 2011-2012, she supported the Erlangen Cluster of Excellence "Engineering of Advanced Materials" as Deputy Executive Director and Scientific Coordinator. After receiving a fellowship grant from the German Research Foundation in 2012, she subsequently moved to Jonathan Coleman's groups at Trinity College Dublin, Ireland. She has published more than 25 papers in peer-reviewed journals, a book chapter and a book.

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