

Many candidates new in the zoo: Towards unifying principles in liquid exfoliation of various layered crystals

Claudia Backes, Applied Physical Chemistry, Heidelberg University

2D materials are exciting for two reasons: i) layer number dependent properties and ii) the broad palette of accessible layered crystals potentially giving access to any desired function. Ten years ago, it was demonstrated that 2D nanosheets can be obtained from layered crystals via liquid phase exfoliation (LPE) resulting in colloidal dispersions. However, sample polydispersity was a problem until recently. Now, we have arrived at a point where size selection (e.g. liquid cascade centrifugation, LCC) and size measurement protocols are in place, which can be readily applied to the whole nanosheet zoo. By comparing various materials, a model to understand the exfoliation was developed.

With our realisation that both size and thickness result in changes in optical extinction spectra due to edge and confinement effects, it became possible to quantitatively determine the nanosheet dimensions optically. Such metrics have now been developed for ~15 materials. The understanding of the optical spectra is useful to monitor degradation kinetics in various liquids as function of time/temperature. Activation energies can be determined and passivation of defects, e.g. by functionalisation, subsequently studied. Functionalisation in general has the potential to ultimately enable the fabrication of hybrids, vertical and horizontal heterostacks etc. for new functional materials.

