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# Studying 2D nanomaterials using Coherent Raman scattering (CARS): the example of Boron Nitride

Boron Nitride (BN) has attracted a lot of interest over the last years, being the counterpart to graphene, the ideal substrate that could preserve the high electron conductivity graphene has to offer. However, contrary to graphene, the lack of an accessible electronic resonance due to the large band gap (>6 eV) of BN makes its spontaneous Raman signal very weak. Mapping BN samples is thus cumbersome and time consuming, each pixel requiring few seconds of exposure time. New BN synthesis methods being such a burning research subject, removing the barriers for efficient characterization of BN appears crucial. Coherent Raman scattering (CRS) [1] techniques, such as coherent anti-Stokes Raman scattering (CARS), or stimulated Raman scattering (SRS) have been applied to many fields, ranging from life science, to solid state characterization. In the last decade, ultrashort laser pulses have been used to generate coherent processes, which greatly enhance the signal up to several order of magnitude. Although of limited interest for graphene [2], CRS appears to be an interesting candidate for 2D nanomaterial characterization when the spontaneous Raman is too weak. Still, research on the subject is scarce: Lafeta et al. [3] presented CARS spectra of hexagonal BN (h-BN), graphene and graphene/h-BN heterostructure, and Ling et al. [4] used SRS for rapid imaging and thickness measurements of h-BN flakes. Here, we present a work on rapid imaging of h-BN flakes using CARS microscopy. A fs/ps-CARS spectroscopy setup [5] was adapted to fit microscopy applications. Coherent Raman response of h-BN is obtained on tens of nanometers thick flakes, and compared it to the spontaneous Raman response. With similar band position and full width half-maximum, high signal enhancement is demonstrated. Thus, hyperspectral imaging of BN flakes is successfully performed within minutes, instead of hours (Figure 1). Thickness sensitivity could be obtained down to 11 nm, according to AFM measurements. This is very promising for fast characterization and quantification of thin h-BN with large spatial extent. Furthermore, this setup may also be well suited for fast detection and identification of other solid compounds. In particular, ongoing studies on simili-explosive species will be discussed in the context of threat prevention.

## References

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## Figures

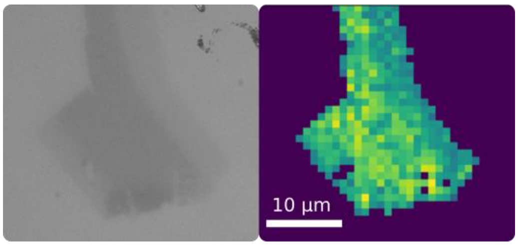


**Figure 1:** Side-by-side comparison of white light image and CARS hyperspectral reconstruction of an h-BN flake. Exposure time/pix = 100 ms.