Scalable synthesis of WS2 on graphene and h-BN: an all-2D platform for light-matter transduction

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Abstract

By exhibiting a measurable bandgap and exotic valley physics, atomically-thick tungsten disulfide (WS2) offers exciting prospects for optoelectronic applications. The synthesis of continuous WS2 films on other two-dimensional (2D) materials would greatly facilitate the implementation of novel all-2D photoactive devices [1-3]. We have demonstrated the scalable growth of WS_2 on graphene and hexagonal boron nitride (h-BN) via a chemical vapor deposition (CVD) approach. Spectroscopic and microscopic analysis reveal that the film is bilayer-thick, with local monolayer inclusions. Photoluminescence measurements show a remarkable conservation of polarization at room temperature peaking 74% (Fig. 1a-b) for the entire WS2 film. Furthermore, we present a scalable approach for the design of photoconductive and photoemitting patterns. By adopting epitaxial graphene on SiC as growth substrate, one can define in a bottom-up fashion photoemitting and photoconducting ribbons (Fig. 1c). The scalable synthesis and design on 2D substrates of WS_2 films with outstanding optical properties is instrumental in the development of novel all-2D quantum optoelectronic and valleytronic devices.

References

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Figures

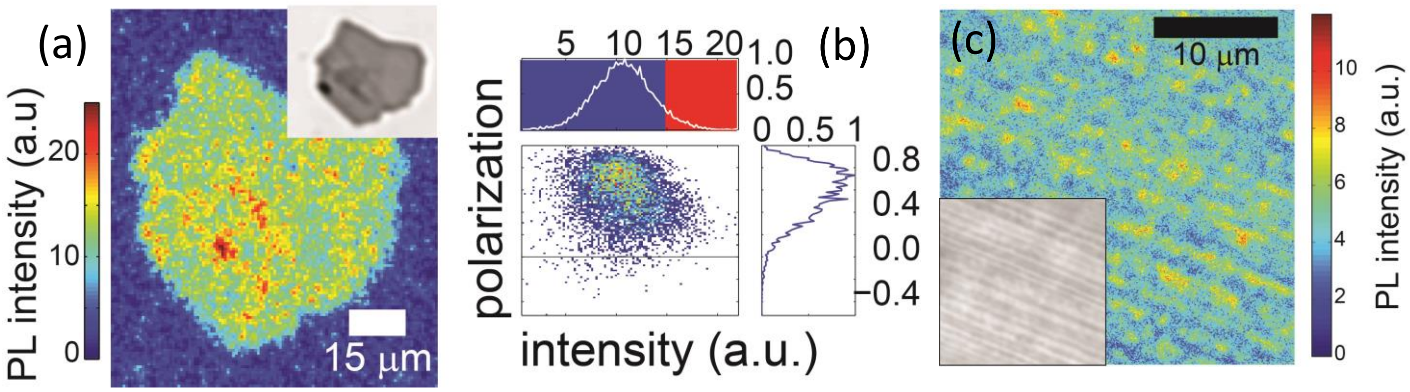

Figure 1. (a) PL intensity map of a selected h-BN flake (also shown in the optical micrograph in the inset) (b) PL polarization vs. PL intensity 2D histogram. The polarization peaks at ~74%. (c) PL intensity map taken from the area shown in the inset. The emission in stronger where WS_2 is on top of buffer layer regions.