

2D semiconductor multilayers for ultra-thin nanophotonic platform

Su-Hyun Gong

¹Department of Physics, Korea University, South Korea.

Email: shgong@korea.ac.kr

Abstract: The emergence of 2D materials stimulated intensive research on both electronic and photonic applications. Especially, transition metal dichalcogenides (TMDs) provided an excellent platform for photonic applications due to their strong light-exciton interaction. Various photonic devices such as a light-emitting device, laser, and exciton-polariton device have been successfully demonstrated experimentally using TMD monolayers. However, multilayered TMDs have attracted far less attention than TMD monolayers because they become indirect bandgap materials. Here I will present that multilayered TMD itself is a good platform for controlling light-matter interaction without integrating an external photonic structure. A TMD multilayer can be utilized for a passive optical structure because it possesses a high dielectric constant. For example, light guiding is possible along a multilayered TMD, which is very thin compared to the wavelength of light. Because a high dielectric constant is owing to the exciton resonances, guided light along a TMD layer is referred to as exciton-polariton. I will also show that light can be further controlled using a patterned TMD multilayer. A patterned WS₂ disk structure has a very high confinement factor for lasing action because the TMD disk offers both optical modes and optical gains. As a result, we observed the lasing operation under continuous-wave excitation at room temperature. We believe our results show potential for the TMD-based nanophotonics offering a small mode volume but with a lower loss compared to the surface plasmon polaritons.