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Enhanced broadband light absorption by WSe2 mono layers via surface plasmon structures

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Abstract
During the last decade, electronic and photonic properties of two-dimensional materials like graphene and transition metal dicalcogenides, have attracted the attention of research in nanophotonics and optoelectronics. Unlike graphene with zero energy gap, transition metal dicalcogenides like WSe2, in their bulk state, have extreme and indirect energy gaps. Moreover, direct bandgaps have approached in visible and infrared regime by reducing the thickness of them to one layer. However, because of their inherent small atomic thickness, these materials face a severe challenge in interaction of light and matter that leads to weak absorption and emission of light. For instance, monolayers of WSe_2 with a thickness of 0.649 nm and an energy gap of 1.64 eV, absorb less than 10 % of incoming light. Therefore, increasing the amount of light absorption in monolayers of WSe_2 and other transition metal dicalcogenides has become an important issue for practical applications in electronic and photonic devices. One solution is the integration of these monolayers and surface plasmon structures. In this paper, we upgrade light absorption in visible and near infrared area to broad band mode by designing a simple unit cell. It is found that the mean absorption of the proposed absorber in the wavelength range of 600 – 850 nm is about 93 %. We have to mention that these simulations have been done by Lumrical software that is based on discretization of Maxwell equations in time and space domains based on the finite difference time domain method.

Keywords: transition metal Dichalcogenides, WSe_2 mono layers, surface plasmon, broadband light absorption, Lumerical package.

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