Universal description of channel plasmons in two-dimensional materials

Channeling surface plasmon-polaritons to control their propagation direction is of the utmost importance for future optoelectronic devices. Here, we develop an effective-index method to describe and characterize the properties of 2D material's channel plasmon-polaritons (CPPs) guided along a V-shaped channel. Focusing on the case of graphene, we derive a universal Schrödinger-like equation from which one can determine the dispersion relation of graphene CPPs and corresponding field distributions at any given frequency, since they depend on the geometry of the structure alone. The results are then compared against more rigorous theories, having obtained a very good agreement. Our calculations show that CPPs in graphene and other 2D materials are attractive candidates to achieve deep subwavelength waveguiding of light, holding potential as active components for the next generation of tunable photonic devices.

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