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Accuracy of the 2D sheet model for atomically thin layers YILEI LI, TONY HEINZ, Stanford Univ./SLAC National Accelerator Laboratory — The 2D sheet model provides a useful and concise description of the optics of atomically thin layers. The 2D sheet model is mathematically equivalent to the conventional thin slab model in the limit where the optical thickness of the layer is negligible. In this paper, we present a detailed analysis of the accuracy of the 2D sheet model for atomically thin layers by comparing numerically the predicted optical response for representative monolayer 2D materials to that obtained from the conventional thin slab model. The agreement between the optical responses produced by the two models is found to be within 0.1%, demonstrating excellent accuracy of the sheet model. Based on the 2D sheet model, we then derive the frequently applied linearized relations between the optical contrasts and the sheet conductivity. The linearized relations provides good accuracy when the material response is weak, but is shown to produce an inaccuracy of more than 25% in certain wavelength window for even a single atomic layer of MoS_2. With the expression for optical transmission from the sheet model, we will clarify a confusion that occasionally arises when determining the optical attenuation by a thin layer.

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