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Optical Properties of Silicon and Tin Nanosheets

The dimensional reduction brought by the advent of two-dimensional (2D) materials opens new routes for nanoelectronics and photonics applications. In this framework, the Xenes - artificial graphene-like monoelemental lattices - represent a new forefront due to their electronic structure that is expected to be tunable by the substrate interaction or surface chemistry [1]. The possibility of hosting Dirac electrons in their band structure makes them particularly interesting also for plasmonics [2]. Epitaxial thin films of silicon and tin could be the experimental way to access the optical properties of silicene and stanene. To this purpose, silicon and tin nanosheets on a transparent substrate like sapphire are investigated by means of optical spectroscopy in the photon range from THz to UV. Here, we report on the Dirac-like electrodynamics in silicon nanosheets deduced from the observation of a low-energy optical conductivity feature, when a 2D regime is approached [3]. Similarly, the same experimental approach is also extended to tin therein showing an unexpected optical behavior with stanene-like properties [4].

References

[1] Molle et al., Nature Materials 2017, 16, 163–169
[2] Lupi and Molle, Applied Materials Today 2020, 20, 100732
[3] Grazianetti et al., Nano Letters 2018, 18, 11, 7124–7132
[4] Grazianetti et al., ACS Applied Nano Materials, Accepted, DOI: 10.1021/acsanm.0c03221

Figures

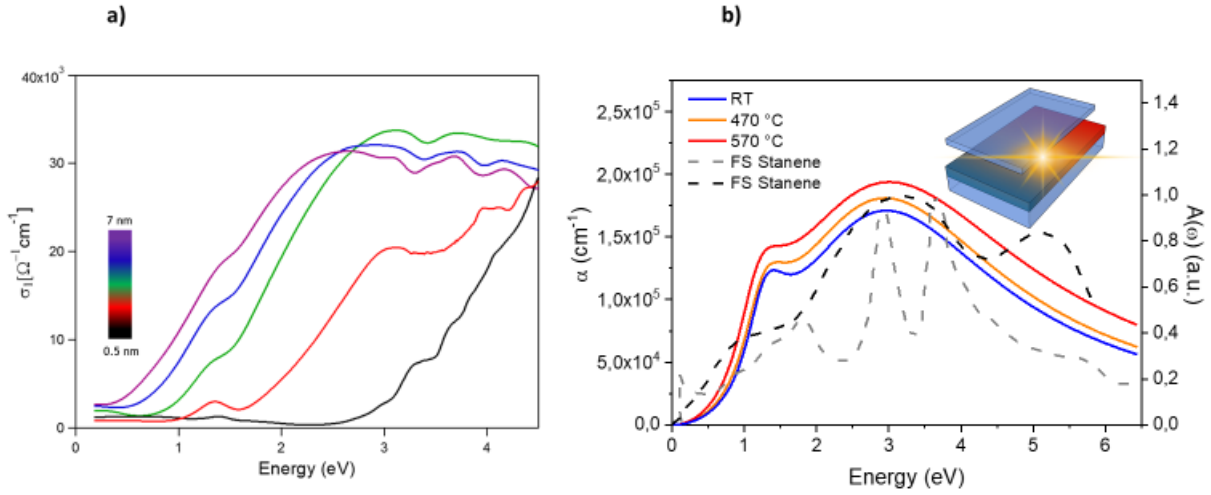

Figure: a) The real part of the optical conductivity of silicon nanosheets. **b)** Absorption coefficients α(ω) of tin films compared with the theoretical absorbance A(ω) of freestanding stanene (black and gray dashed lines).