Enhancing the absorption of Single Layer Graphene: simulation and experimental study in symmetric and asymmetric NIR Fabry-Perot filters

Maria Luisa Grilli

ENEA

Abstract

There is a growing interest towards graphene and 2D materials for their exceptional optical and electronic features which make them unique for photonic and optoelectronic applications. Achieving extraordinarily high absorption by the electric field enhancement on a single atomic plane is a challenging goal. We have simulated with COMSOL Multiphysics and demonstrated experimentally for the first time a great enhancement in the absorption of single layer CVD graphene due to the electric field enhancement inside symmetric or asymmetric Fabry-Perot filters fabricated by radio frequency sputtering. A maximum experimental absorption of 84% peaked at 3150 nm was obtained in case of an asymmetric Fabry- Perot cavity, in excellent agreement with simulations. Absorption intensity and bandwidth were also modeled as a function of the incident angle of the electromagnetic radiation, and Raman measurements have proven the effectiveness of the fabrication method in preserving graphene's physical properties, disclosing exciting potentialities for building narrow band NIR optical devices based on 2D materials. By opportunely choosing the combination of the layer materials and their thickness, the absorption of SLG can be achieved at different wavelengths ranging from Vis to IR.