Robust optical absorption of graphene-polymer heterostructures for GHz electromagnetic radiation versus defects

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Abstract

Graphene-PMMA heterostructures present good shielding efficiency against GHz electromagnetic radiations [1]. Theory and experiments demonstrate that there exist an optimum number of seven graphene sheets separated by thin polymer spacers to obtain maximal absorption. This is explained by an arithmetic addition of graphene sheet conductivies for small number of layers. In the present work, reflectivity, transmittance and absorbance of multilayered material are obtained using Rigorous Coupled Wave Analysis (RCWA) and compared to experimental measurements realized in the K_a band.
When the material properties are no longer uniform in the directions parallel to the surface, absorption properties may be affected. For instance, the graphene layers produced by CVD present microscopic holes or microscopic dots (embryos of a second layer). Numerical calculations show that the absorption of the optimum graphene/PMMA sandwich is robust in the sense that it does not depend strongly on graphene defects to first order in concentration (Figure 1). This property is not true when the number of layers deviates from the optimum value N=7. We also demonstrate that grain boundaries in graphene do not compromise the good shielding efficiency of the proposed absorption device.

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References

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Figures

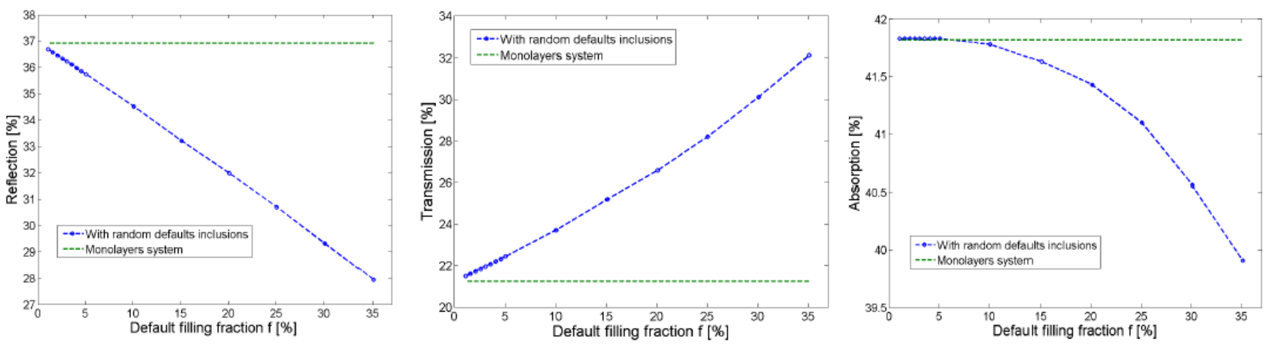

Figure 1: Reflexion, transmission and absorption properties of graphene-PMMA heterostructures (N = 7 layers) versus filling fraction of random holes that may be present in graphene sheets.