Tunable Fano Resonance in Graphene Based Periodic Structure

H. Amarloo, and S. Safavi-Naeini
Electrical and Computer Engineering Department, University of Waterloo
Waterloo, ON, Canada

Engineered material have found many applications in all ranges of frequencies, because new electromagnetic properties can be achieved using these structures. Considering trasnmission of EM wave through a planar 2D periodic structure, some resonances can be seen in the transmitted signal. These resonaces have very low quality factor (Q), because the resonating elements in the structure are strongly coupled to the radiation into the free space. It has been shown that by introducing some small asymmetry in the structure, high Q resonances can be achieved. These sharp asymmetric resonances are called Fano resonances.

Graphene is a two dimensional material with unique electrical and optical properties, which is the topic of many researches at different ranges of frequency. It has very high carrier mobility and its characteristic can be tuned optically and electronically. Graphene has been widely explored for terahertz applications. It is one of the most important candidates for low loss plasmonic based devices in terahertz range.

In this paper we propose a new graphene based periodic structure, which shows Fano resonances at terahertz frequencies. We also show that the Fano resonance in the proposed structure can be tuned by changing the bias voltage of graphene over a large frequency band. The structure is simulated using HFSS, in which graphene is modeled as a very thin layer, on top of the high resistive silicon substrate. The dimensions of the periodic structure are optimized to maximize the quality factor (Q) of the Fano resonances.

Acknowledgement

This work was supported by Natural Science and Engineering Research Council of Canada (NSERC), and BlackBerry (former Research in Motion).