Microwave Radiation from monolayer graphene

Anestis Katsounaros*(1), Matthew T. Cole(2), Hatice M. Tuncer(2), William I. Milne(2), and Yang Hao(1)
(1) School of Electronic Engineering and Computer Science, Queen Mary, University of London, Mile End Road, London, E1 4NS, UK
(2) Department of Engineering, University of Cambridge, 9 JJ Thomson Avenue, Cambridge, CB3 0FA, UK

Graphene is a two-dimensional, single atomic thick layer of hexagonally latticed carbon atoms. Since its unexpected existence was verified focus has shifted toward retrofitting graphene - with all its unique electrical, optical and mechanical properties (K. S. Novoselov et al., Nature, 438, 197, 2005) - into existing technologies.

This work, is focused on the use of monolayer graphene as a radiating element. Near-field measurements were performed at X-band frequencies for graphene on copper microstrip transmission lines. The radiation patterns are taken and compared to a similar structure on the absence of graphene where a weak radiation was observed. Evidently, graphene has relatively low conductivity at microwave frequencies compared to bulk copper.

The sheet resistivity of graphene is typically 1 kΩ/sq. in DC and around 700 Ω/sq. at optical frequencies (Reina et al., NanoLetters, 9, 30, 2009). However, to the best of the authors knowledge, the surface resistivity of monolayer graphene at microwave frequencies has not been investigated to-date. A CST-Microwave Studio model was developed based on the structure described above. Our empirical S–parameters were used as target conditions for optimization. A dimensionless cost function (fc) was specified relating sheet resistivity (Ω/sq.) to the S–parameters. fc was terminated for values $< 10^{-6}$. The optimized sheet resistivity is calculated and an approximate linear fit will result to a dc surface conductivity of 985 Ω/sq.

This study provides compelling evidence on the electronic properties of graphene which may ultimately lead to a variety of novel microwave applications.