The line-edge roughness scattering in a Graphene Nanoribbons based Infrared Photodetector

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BIOGRAPHY

Asghar Asgari: Asghar Asgari is borne in Iran 1973. He got his BSc and MSc in solid state physics and electronics from university of Tabriz, Iran. He got his PhD under Prof. Kalafi from University of Tabriz and Prof. L. Faraone from University of Western Australia, supervisions. In 2002 he joined microelectronics research group in the University of Western Australia as research associate. In 2004, he started his work in Photonics group at the University of Tabriz in Iran. Currently he is Professor in photonics group and also Adjunct Senior research fellow in Microelectronics Research group at the University of Western Australia.

Asghar's main research interest is the study of electrical and optical properties of Graphene and III-nitride based material, and also the optoelectronic device modeling (from bulk to nano).

TECHNICAL ABSTRACT

Graphene nanoribbons (GNRs) have attracted much attention because of their properties and their potential in designing high performance devices. The most important advantage of graphene relates to control of energy gap in wide range by patterning of graphene into an array of narrow strips, nanoribbons, and by varying the transverse electric field in different gated hetrostructures. The edge shape of nanoribbons dictates their classification in Armchair (A) and Zigzag (z) ones, thus determining their band structure and optical absorption.

At low field regime, the carrier transport in GNR is affected by various scattering mechanisms. If we consider a GNR without any chemical doping, the acoustic and optical phonon scattering and line edge roughness scattering (LER) are expected to play an important role in scattering rate of GNRs. The LER scattering leads to a spatially modulated band gap and resulting fluctuation in the band edge potential causes the scattering of carrier.

In this paper we have calculated the generation and recombination rate of pure A-GNR due to the LER scattering mechanisms, for a GNR based IR-detectors at different carrier concentration, temperature and different nanoribbon widths.

Our modeling results show that the generation and recombination rates due to LER scattering is less sensitive to temperature and decrease by increasing the A-GNRs width, and increasing with doping density increasing.

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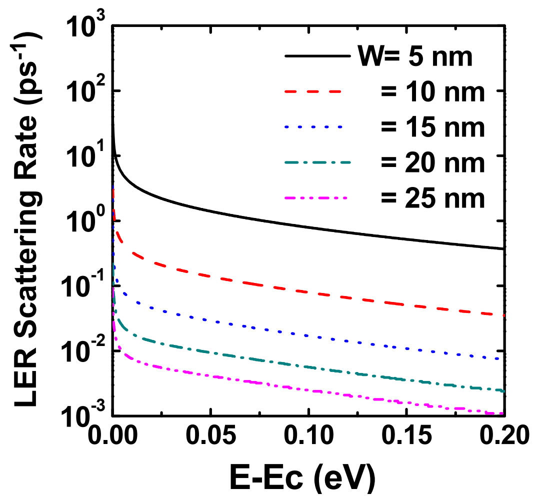

Fig 1 The LER scattering rate as a function of carrier energy for A-GNR with different widths (W=5, 10, 15, 20 and 25 nm) at T=300 K.

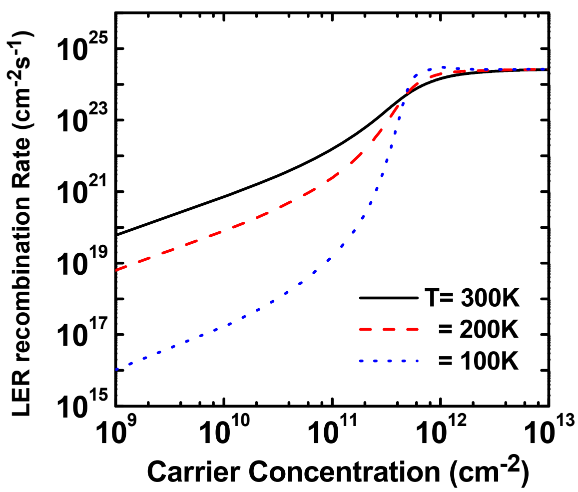

Fig 2- The recombination rate of A-GNR with W=5 nm, due to LER scattering, as a function of electron and hole concentration, which assumed to be equal, for different temperatures, T=100, 200 and 300K.

Keywords: A-GNR, line edge roughness scattering, IR-detectors,