# Terahertz emission form optically pumped carbon nanotube films

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Interband transitions in solids allow for the creation of room temperature operating emitters and detectors of radiation from mid infrared to ultraviolet optical ranges. Extending this approach to THz frequency range is yet to be attained. Quasimetallic carbon nanotubes (CNTs) that have curvature-induced bandgaps of several meV show great promise in this respect. It has been recently pointed out that the matrix element of dipole transitions in those 1D narrow-gap semiconductors has giant enhancement at the band edge and then decays quickly away from the band edge [1]. The transition matrix element enhancement is due to curvature effects – the same effects are responsible for gap opening in quasi-metallic nanotubes . Along with the van Hove singularity at the band edge this results in a giant enhancement of the probability of optical transitions near the band edges.

In this work we report on observation of THz room temperature emission from carbon nanotube film illuminated by visible range laser radiation. We show that this emission originates not only from thermal radiation of the CNT film heated by the optical excitation. Analysis of the polarization of emission of optically pumped CNT film and comparison to that of the same film heated above room temperature unambiguously shows that significant fraction of the emission in the former case occurs due to interband transitions in quasimetallic carbon nanotubes stimulated by optical excitation of charge carriers. This contribution is observed for frequencies up to 7 THz. The observed experimental data are analyzed within the analytical approach developed in the Ref. 1 and are found to be in good agreement with theoretical modeling. Our result open pathway for creation of novel terahertz radiation sources based on quasimetallic CNTs.

[1] Hartmann, R. R., V. A. Saroka, and M. E. Portnoi. "Interband transitions in narrow-gap carbon nanotubes and graphene nanoribbons." Journal of Applied Physics 125.15 (2019).