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Tunable Quantum-Enhanced Second-Order Optical Nonlinearity From Bilayer Graphene SANFENG WU, Department of Physics, University of Washington, Seattle, 98195, United States, LI MAO, Department of Physics and Astronomy, Washington State University, Pullman, WA, 99164 USA, WANG YAO, Department of Physics and Center of Theoretical and Computational Physics, The University of Hong Kong, Hong Kong, China, CHUANWEI ZHANG, Department of Physics and Astronomy, Washington State University, Pullman, WA, 99164 USA, XIAODONG XU, Department of Physics and Department of Material Science and Engineering, University of Washington, Seattle, 98195, United States — Bilayer graphene exhibits a tunable band gap when the inversion symmetry is broken. It therefore stimulates much interest on its physical characterization and practical application for mid-infrared (MIR) optoelectronics. Here we focus on its second order nonlinear optical response to the MIR laser excitation under device condition, following a quantum description of nonlinear optical conductivity. Our theoretical study shows that, for a certain laser-frequency range determined by the band-gap, giant second harmonic generation can be excited due to the intrinsic electronic spectrum of bilayer graphene. Electrically tunable $\chi^{(2)}$ on the order of $10^5 pm/V$ can be achieved, 3 orders of magnitude larger than the widely-used nonlinear crystal AgGaSe2.

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