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Title:Effect of heating and cooling of photogenerated electron-hole plasma in optically pumped graphene on population inversion

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Abstract:We study the characteristics of photogenerated electron-hole plasma in optically pumped graphene layers at elevated (room) temperatures when the interband and intraband processes of emission and absorption of optical phonons play a crucial role. The electron-hole plasma heating and cooling as well as the effect of nonequilibrium optical phonons are taken into account. The dependences of the quasi-Fermi energy and effective temperature of optically pumped graphene layers on the intensity of pumping radiation are calculated. The variation of the frequency dependences dynamic conductivity with increasing pumping intensity as well as the conditions when this conductivity becomes negative in a certain range of frequencies are considered. The effects under consideration can markedly influence the achievement of the negative dynamic conductivity in optically pumped graphene layers associated with the population inversion and, hence, lead to the in-depth understanding of the experimental results and the realization graphene-based terahertz and infrared lasers operating at room temperatures. © 2011 The Japan Society of Applied Physics.