Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Spin-dependent phonon-assisted optical transition in Si and Ge under strain[1] PENGKE LI, Department of Electrical and Computer Engineering, University of Rochester, Rochester, New York, 14627, DHARA TRIVEDI, Department of Physics and Astronomy, University of Rochester, Rochester, New York, 14627, HANAN DERY, Department of Electrical and Computer Engineering, University of Rochester, Rochester, New York, 14627 — In indirect bandgap semiconductors like Si and Ge, the transfer of angular momentum between free carriers and photons is intricate since they involve both radiation-matter and electron-phonon interactions. Moreover, the multi-valley conduction band of Si and Ge leads to dependence on light propagation. By breaking the degeneracies of conduction valleys and of valence bands, strain could be used as an experimental tool to regulate and validate the relation between the measured circular polarization degree of photons and the spin polarization of charge carriers. Using symmetry arguments, we present a theoretical study of the spin-dependent selection rules for various phonon-assisted optical transitions. We show how these selection rules are changed under different configurations of strain. These selection rules are verified by rigorous numerical calculation of the spin-dependent luminescence spectra in strained Si and Ge, as well as in relaxed SiGe alloys. Lastly, we also provide results of the inverse process, namely optical orientation.

[1]NSF-NRI Contract DMR-1124601 (NEB 2020), NSF Contract ECCS-1231570

Pengke Li
Department of Electrical and Computer Engineering,
University of Rochester, Rochester, New York, 14627

Date submitted: 08 Nov 2012 Electronic form version 1.4