Stimulated terahertz emission due to electronic Raman scattering in silicon

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Silicon-based semiconductors are intensively investigated over the past years as promising candidates for optoelectronic devices at terahertz (THz) frequencies [1]. Optically pumped intracenter silicon lasers, realized in the past decade in the THz range, are based on direct optical transitions between shallow levels of different shallow donors [2]. Recently, terahertz Raman laser emission has been demonstrated in silicon doped by antimony [3] and phosphorus [4].

We report on realization of terahertz lasers based on intracenter electronic Raman scattering in silicon doped by arsenic (Si:As, frequency range 4.8 – 5.1 THz and 5.9 – 6.5 THz) and silicon doped by bismuth (Si:Bi, 4.6 – 5.9 THz) under optical excitation by infrared frequency-tunable free electron laser at low lattice temperatures. The Stokes shift of the observed laser emission is equal to the Raman-active donor electronic transition between the ground 1s(A_1) and the excited 1s(E) donor states. Raman terahertz gain of the lasers is similar to those observed for the donor-type terahertz silicon donor lasers.

References

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