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Large vacuum Rabi splitting for a semiconductor nanogap cavity MITSUHARU UEMOTO, HIROSHI AJIKI, Osaka University — A metallic nanogap utilizing surface plasmon excitation is one of the most popular designs of an optical antenna converting propagating radiation into enhanced fields at a nanoscale area (hotspot). Similarly, a nanogap structure consisting of a semiconductor dimer also causes the hotspot due to exciton. This semiconductor nanogap acts as a high-Q microcavity because of the small losses of the exciton resonance, for example, the Q factor of the nanogap structure whose long axis is smaller than 32 nm becomes $\approx 10^4$ [1]. This fact is quite contrast to the low-Q factor ≈ 10 of a metallic nanogap . In this work, we theoretically demonstrate the vacuum Rabi splitting of a two-level system placed at the semiconductor nanogap cavity. The resulting splitting energy reaches ≈ 0.5 meV for dipole moment 10 D of the two-level system, which is much larger than the splitting energy of matter with the same dipole moment embedded in a photonic-slab cavity [2].

[1] M. Uemoto and H. Ajiki, in preparation.
[2] T. Yoshie et al., "Vacuum Rabi splitting with a single quantum dot in a photonic crystal nanocavity," Nature, vol. 432, pp. 9-12, 2004.

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