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Cross Resonant Quadruple-ridge Apertures for Nanoscale Optical Emitters AKIHIRO KIRIHARA, JUNICHI FUJIKATA, NEC Corporation, TOSHIHIRO NAKAOKA, NAOTO KUMAGAI, KATSUYUKI WATANABE, SHUNSUKE OHKOUCHI, University of Tokyo, MASAYUKI SHIRANE, SHINICHI YOROZU, NEC Corporation, YASUHIKO ARAKAWA, University of Tokyo —
Plasmonic antenna effect in metal nanostructures has gained much interest because of its useful properties for nanophotonic devices such as quantum-dot photon emitters. In this presentation, we report on polarization-independent quadruple-ridge (QR) apertures to improve photon extraction efficiency from single quantum dots (SQD). The QR aperture has four metallic tips protruding perpendicular to each other, which work as a polarization-independent antenna for a SQD just below the tips. We designed the gold QR apertures for SQD devices emitting around 1 um using FDTD simulation, and fabricated them by EB lithography and lift-off technique. By means of transmission spectroscopy, we demonstrated antenna-induced transmission enhancement through QR apertures for any optical polarization. The enhancement factor was more than 10 compared to that through conventional circular apertures. Because our QR aperture works not only as an optical antenna but also as an electrode for SQDs, it will be applicable to electrically-driven single photon generators or detectors.

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