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Research highlights

Nanoscale photonic integrated circuit using surface plasmon polaritons on silicon

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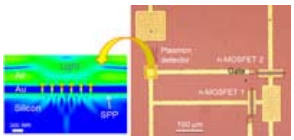
Surface plasmon polaritons (SPPs) are waves that propagate along the surface of a conductor and collective oscillation of electrons coupled with the optical field in the nano-scale area beyond the diffraction limit of propagating light waves. Recently, there is increasing interest in SPPs as signal carriers in nanoscale integrated circuits.

Many researchers are developing photonic devices employing SPPs for applications to photonic integrated circuits.

Here, Mitsuo Fukuda and his group at Toyohashi University of Technology (Toyohashi Tech) have developed a nanoscale integrated circuit consisting of SPP and electron devices on silicon in cooperation with the Integrated Circuit and Sensor System Group.

The integrated circuit consists of a SPP detector and two metal-oxide- semiconductor field-effect transistors (MOSFETs). The SPP detector was a gold/silicon Schottky-junction diode with multi-grating slits and fabricated on the gate electrode of a MOSFET. Free electrons excited by SPPs within the gold-metal cross over the junction and result in photocurrent to drive the MOSFET. The SPPs were converted from propagating 1550-nm-wavelength light at the multi-grating slit.



Top view of the integrated circuit (right) and cross sectional view of simulation result for SPP detector.

The integrated Schottky-junction diode drove the MOSFET well with a 1550-nm- wavelength light beam which is transparent to silicon. The photocurrent detected at the Schottky diode was amplified by about 14000 times in the integrated circuit.

This device is expected to contribute to a new phase of nano-scale photonic integrated circuits on silicon.

Reference:

Authors: T. Aihara, M. Fukuhara, A. Takeda, B. Lim, M. Futagawa, Y. Ishii, K. Sawada, and M. Fukuda.
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