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Iridium-based superconducting optical transition edge sensor for single-photon detection

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Optical quantum imaging or information processing is expected to be a new technology to surpass classical noise and resolution limit by fully exploiting the characteristics of non-classical photon sources. In such applications, photon-number resolving capability and high detection efficiency is required for the photon detector. The superconducting transition edge sensor (TES) is the ideal detector for this application, since it has the nearly 100 % detection efficiency with optical cavity structure and the almost linear response to simultaneously absorbed multi-photons. A TES consists of a superconducting thin film which is biased with a constant voltage. When optical photons are absorbed in the film, the photon energies are transformed into a very small increase of temperature in the film and hence the increase of its resistance, causing small current signal which is measurable with superconducting quantum interference device (SQUID).

To enhance the energy resolution of optical TES and hence its photon number resolving capability in near infrared regions, we are developing optical TES based on single-layer iridium film by exploiting its very low transition temperature (140 mK in bulk). We fabricated optical TES with iridium film with the minimum size of 7×7 μm^2. The iridium film was deposited on SiN/Si/SiN substrate, and Nb contact electrodes were formed. We confirmed the response to optical photons in near infrared wavelengths (860 nm and 1310 nm) using iridium optical TESs. The design of optical cavity structure for iridium TES is ongoing, and its performance will be discussed too.