Ultra-low Noise TES bolometer Arrays for SAFARI Instrument on SPICA

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SPICA (SPace Infrared telescope for Cosmology and Astrophysics) is a future space mission for mid- and far-infrared (IR) astronomy. By having a large (2.5 m) and cooled (< 8 K) telescope combined with ultra sensitive IR detectors, SPICA provides an opportunity to make natural background-limited observations over the wavelength range from 17 to 230 μm. One of the instruments aboard SPICA is SAFARI (SpicA FAR-infrared Instrument), which is a grating spectrometer covering the full 34-230 μm wavelength range. SAFARI detectors are transition edge sensor (TES) bolometers for three wavelength bands: S-band for 34-60 μm, M-band for 60-110 μm, and L-band for 110-230 μm. Each band requires a large number of pixels (~ 600-2000 pixels) and an extremely high sensitivity (electrical Noise Equivalent Power, NEPel ~ 2×10^{-19} W/√Hz at frequencies below ~ 100 Hz). SRON is developing ultra-low noise TESs based on a superconducting Ti/Au bilayer on a suspended SiN island with SiN legs. The pixel size is ~ 800×800 μm^2. Three types of TESs were fabricated on SiN islands with different sizes and with and without optical absorbers. These TESs have thin (0.20 μm), narrow (0.5-0.7 μm), and long (340-460 μm) SiN legs, and show *Tc* of ~ 93 mK and *Rn* of ~ 158 mΩ. They were characterized under AC bias using a Frequency Division Multiplexing readout (1-3 MHz) system. The TESs without absorber show NEPs as low as 1.1×10^{-19} W/√Hz with response time of below 1 ms,. For the TESs with absorber, we confirmed a higher NEPel ($\sim 5\times10^{-19}$ W/√Hz) than that of TESs without the absorber, due to the stray light.