Antenna-coupled Transition Edge Polarization-sensitive Bolometer Arrays

Minhee Yun[1a], James Bock[1], Henry LeDuc[1], Peter Day[1], and Moon J Kim[2]

[1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109
[2]Department of Material Science and Engineering, University of North Texas, Denton, TX 76203, U.S.A.

We have fabricated antenna-coupled superconducting transition edge sensor (TES) arrays for far-infrared and millimeter-wave applications. The advantage of antenna coupling is that the large optical coupling structure required for far-infrared/millimeter wavelengths is not thermally active. The sensor can thus be as small as lithographic techniques permit. By eliminating large absorbers, this technology enables bolometers working at frequencies as low as 30 GHz, covering the entire spectral region of interest for future space-borne studies of cosmic microwave background polarization. We have developed a focal plane architecture with dual-polarization sensitivity in a single spectral band, or single-polarization sensitivity in multiple spectral bands.

We use TES layers consisting of Al/Ti/Au/Ti thin films and Nb electrical contacts on a low-stress silicon nitride membrane. Using engineering statistical methods, we show that the factors important in the TES sensing temperature are, in decreasing order of importance, Al, Au thicknesses, and interaction between Al/Au layers. It is known that Ti layer acts as a diffusion barrier to avoid damage of the aluminum contact and Au layer. We have extensively investigated interfaces of Al/Au and Al/Ti/Au using tunneling electron microscopy(TEM), showing Al diffusion into Au and Ti, and transition temperature, as a function of process temperature and film composition.