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Development of a high yield fabrication process for the US SpicA FAR infrared Instrument (SAFARI) detector arrays

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We present a high-yield absorber-coupled transition-edge sensor (TES) fabrication process which can field kilopixel-scale arrays with a noise equivalent power (NEP) of 1x10^-19 W/rtHz as targeted by the US SpicA FAR infrared Instrument (SAFARI) proposed to fly on the Space Infrared Telescope for Cosmology and Astrophysics (SPICA). Each pixel consists of a metal film absorber patterned onto a thin silicon nitride membrane with four support beams holding the membrane. The support beams have dimensions equal to 1000 um long by 0.4 um wide by 0.25 um thick. The thermistor is a titanium/gold bilayer with a transition temperature near 100 mK. With this design, it is possible to achieve SAFARI's NEP requirement. Here we report on key fabrication techniques which overcome limitations in our previous process flow where our use of xenon difluoride (XeF2) to release the free-standing silicon nitride membrane introduced excess heat capacity and, thus, slowed the response time of the TES significantly. The new process will allow us to meet the response time requirement of US SAFARI.

Less than 5 years of experience since completion of Ph.D

N

Student (Ph.D., M.Sc. or B.Sc.)

N

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