



Advanced ACTPol Multichroic Horn-Coupled Polarimeter Array Fabrication on 150 mm Wafers

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Advanced ACTPol is an experiment to measure polarization in the cosmic microwave background that will begin in 2016 using the Atacama Cosmology Telescope (ACT), a six meter telescope in the Atacama desert of Chile. Advanced ACTPol will replace the ACTPol instrument, which is currently taking data. Both Advanced ACTPol and ACTPol employ feedhorn-coupled polarization-sensitive TES detectors. This combination of coupling and sensor technology shows repeatable band edges, excellent noise performance, fast time constants, excellent beam properties, and high coupling efficiencies. The Advanced ACTPol multichroic polarimeter arrays, now being fabricated at NIST, will occupy five bands spanning 25 - 280 GHz and will consist of a total of nearly 5800 AlMn-based TES bolometers, giving rise to increased sensitivity and mapping speed compared to ACTPol. The high frequency (HF) array, having bands centered at 150 GHz and 230 GHz, is the first of the three multichroic arrays to be developed and fabricated. In addition to the second band at 230 GHz on the same focal plane, the Advanced ACTPol HF array shows an improvement in mapping speed of 40% over the ACTPol 150 GHz array. In order to facilitate these performance improvements, we have transitioned the traditional 3 inch diameter array fabrication process to 150 mm wafers in order to achieve a higher pixel density. This doubling in wafer diameter has allowed (and also required) improved tuning of dielectric loss, sensor critical temperature (~160 mK), heat capacity, and overall uniformity. An increasingly large and complex sensor array which has four detectors per pixel requires similarly complex parallel and perpendicular wiring tracks. In order to minimize the probability of wiring shorts, we have developed automated layout tools that render sophisticated and customized wiring and bond pad layouts for the rhombus-based unit-cell geometry employed in the array. Additionally, we have designed and fabricated microwave cross-under structures to minimize reflections and crosstalk between adjacent channels. Many of these improvements have been specifically developed to increase array yield. In addition to describing the process improvements above, we will present the status of the HF detector arrays for Advanced ACTPol.

150/220 GHz Advanced ACTPol Polarimeter

