

Broadband Antireflective Subwavelength Structures for Large Diameter Silicon Lenses

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We have been developing a millimeter-wave camera with microwave kinetic inductance detector (MKID) for ground based wide field-of-view observations. In our cold optics design, two silicon lenses with diameter of 200-mm and 300-mm are used as focusing elements. Silicon is ideal because of their low dielectric loss and high refractive index, but an anti-reflection coating is required to reduce reflections at the surfaces. To solve this problem, we introduce an antireflective subwavelength structure. The antireflective subwavelength structures have some merits compared with dielectric material coatings because the structure acts as an antireflective layer with only one material.

To get a larger bandwidth, taper structures with period of 265- μ m and depth of 700- μ m were fabricated on a silicon flat sample by a special dicing blade. The transmittance of structure was measured with a Fourier Transform Spectrometer at cryogenic temperatures. In the result, the measured average transmittance between 170- and 350-GHz was about 94%, and the measured result is in good agreement with the simulation. We present fabrication, simulation and measurement results.