A planar frequency selective bolometric array at 350 GHz

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Planar bolometric imaging arrays are becoming increasingly diverse in kind due to their simple design and scalability. Frequency selective bolometric designs [1] have earlier coupled bolometers with frequency selective quasioptical interference filters as compact sub-millimetre radiometers. Here we describe a bolometric focal plane array consisting of the Cold-Electron Bolometer [2] (CEB) integrated in a frequency selective surface (FSS) fabricated on a Silicon substrate with a backshort. This array is formed by a periodic pattern of conducting annular square elements and the two-terminal CEB is embedded directly in the elements' arms. The CEBs impedance has been matched to the FSS which provides resonant interaction with sub-millimetre radiation. A further degree of freedom for the tuning is via varying the thickness of the substrate. We've been able to design the FSS at 350 GHz with peak coupling of more than 90% as is common for FSS based filters. The integrated CEB array has been designed for a photon noise limited performance with cold JFET amplifiers for optical power loads between 15 pW to 80 pW. This design can fit the requirement of balloon-borne CMB missions like OLIMPO. A prototype of such a detector has been fabricated and optical response to blackbody radiation has been measured, indicating responsivity up to $5*10^8$ V/W and higher. FSS based structures exhibit narrow bandwidths and we're in the process of optimisation of our imaging array to achieve bandwidth of more than 10% required for OLIMPO telescope. The details of this new concept, together with numerical simulations and optical measurements will be presented.

References

1. Kowitt, M. S., Fixsen, D. J., Goldin, A., & Meyer, S. S. (1996). Frequency selective bolometers. Applied optics, 35(28), 5630-5635.
2. L. Kuzmin, Optimization of the hot-electron bolometer for space astronomy, SNED Proc., pp. 145-154, Naples (2001).