Development of Blocked-Impurity-Band-type Ge detectors fabricated with the surface-activated wafer bonding method for far-infrared astronomy

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We report on the development of new low-temperature photoconducting detectors. To realize large-format compact array detectors covering a wide far-infrared wavelength range up to 200 μm, we develop Blocked-Impurity-Band (BIB) type Ge detectors with the room-temperature, surface-activated wafer bonding method. The detectors consist of a heavily-doped Ge:Ga (p+ layer) for detecting far-infrared photons and a non-doped intrinsic Ge (i layer) for blocking the dark current. A cutoff wavelength can be extended by using shallower energy levels of the impurity band without mechanical stress, which is required for conventional Ge:Ga bulk photoconductors.
We fabricated p+-i junction devices which possess a BIB-type structure, and measured their absolute responsivity at low temperatures using an internal blackbody source in a cryostat. We also evaluated their spectral responses using a Fourier transform spectrometer. The overall result of our measurement shows that the p+-i junction devices possess a promising applicability as a new far-infrared detector to cover wavelength from 100 to 200 μm with high responsivity. As a next step, we plan to fabricate a BIB-type array device in combination of a low-power cryogenic readout integrated circuit.