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Development of Superconducting Tunnel Junction Detector using Hafnium for COBAND experiment

We present the development of Superconducting Tunnel Junction detector using hafnium (Hf-STJ) as far-infrared single photon detector for the COsmic BAckground Neutrino Decay search (COBAND) experiment.
The photon energy spectrum from the radiative decays of cosmic background neutrino is expected to have a sharp edge at high energy end in a far-infrared region ranging from 15 to 30meV in the cosmic infrared background and the overwhelming infrared foreground from zodiacal emission.
Thus, the detector should identify individual photons with sufficiently high energy resolution, in order to gain the best signal-to-noise ratio for identification of the edge structure.
One of our choices for the detector is Hf-STJ which is expected to have 2% energy resolution for single photon of 25meV due to very small gap energy of hafnium.
We have successfully produced a superconducting-insulator-superconducting structure using hafnium, that is confirmed by Josephson current, and observed a response to visible light illumination.
However it has large leakage current and it is necessary to perform improvements very much.
To reduce leakage current, we reviewed structure of Hf-STJ.
We newly produced Hf-STJ which has structure composed of hafnium/aluminum/hafnium-oxide/hafnium, and measured its characteristics.
Josephson current and the response to visible laser pulse are observed.
Leakage current density of a new type of Hf-STJ become 16 times smaller than old Hf-STJ.
However, as our Hf-STJ still have larger leakage current than requirement from COBAND experiment, optimization is underway.

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