

YBaCuO Josephson generators as THz sources for bolometer characterization

L.S. Revin^{1,2}, A.L. Pankratov^{1,2,3}, D.V. Masterov¹, A.E. Parafin¹, S.A. Pavlov¹, A.V. Chiginev^{1,2}, I.V. Rakut^{2,3}, A.V. Gordeeva^{1,2}, V.O. Zbrozhek², A.V. Blagodatkin^{1,2}, L.S. Kuzmin^{2,4}

In a long junction the mode of fluxon motion may occur under the action of external magnetic field in which solitons are created at one edge of the junction, move along the junction, and are radiated at the other edge. Such regimes can be useful in creation of THz band oscillators [1], heterodyne and Hilbert spectrometers.

New technology of preliminary mask (PM) with CeO₂ buffer layer, which determines the necessary topology of the structure directly during the growth of the YBCO film has been developed [2]. The PM method has been successfully used to create Josephson junctions on a bicrystal YSZ substrate with a sublayer of epitaxial cerium dioxide CeO₂.

To register the radiation from long bicrystal junction the sample of Cold Electron Bolometer (CEB) [3] was used. CEBs represent SINIS junctions with nanoabsorber made of aluminum with suppressed superconductivity. CEBs are connected in series and parallel at DC for optimal matching with the amplifier. A pair of half lambda dipoles with wide electrodes is connected to another pair by high-inductive 1 μm wide lines. The design is optimized for the frequency band of 240-280 GHz.

Changing the current through the Josephson junction the bolometer response was measured as well as the voltage on YBCO oscillator (Josephson frequency $f = 2eV_{YBCO}/h$). Figure 1 shows the bolometer response for each radiation frequency. Comparing the result with the CEB amplitude-frequency characteristic based on the calibrated backward-wave source (enlarged part of Fig. 1), it can be concluded that the signal peaks are determined by the characteristic of the receiving system rather than the oscillating one.

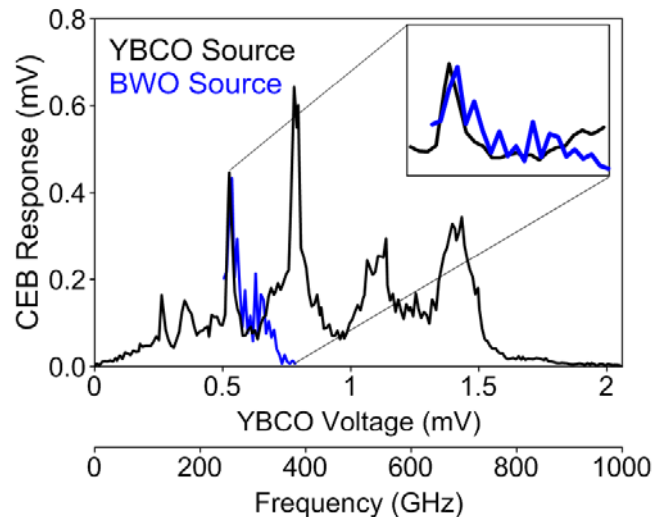


Fig. 1. Maximum registered response of the bolometer depending on the frequency of radiation. Comparison with experiments using BWO.

In conclusion, the samples of YBCO long Josephson junctions on YSZ bicrystal substrate have been fabricated using original technology of preliminary topology mask and good characteristics of the samples have been achieved. Using the cold-electron bolometer, the subTHz emission up to 900 GHz was registered. It can also be used as a THz band cryogenic network analyzer in combination with a cryogenic bolometer.

The work is supported by RSF (projects 16-19-10478 and 16-19-10468).

REFERENCES

- [1] Stepantsov, E., Tarasov, M., Kalabukhov, A., Kuzmin, L., Claeson T., "THz Josephson properties of grain boundary YBaCuO junctions on symmetric, tilted bicrystal sapphire substrates", *Journal of Appl. Phys.* 2004. V. 96, No. 6. P. 3357.
- [2] Masterov, D.V., Parafin, A.E., Revin, L.S., Chiginev, A.V., Skorokhodov, E.V., Yunin, P.A., Pankratov, A.L., "YBCO long Josephson junctions on bicrystal Zr_{1-x}Y_xO₂ substrates fabricated by preliminary topology masks", *Supercon. Sci. Technol.*, vol. 30, no. 2, pp. 025007, 2017.
- [3] A.V. Gordeeva, V.O. Zbrozhek, A.L. Pankratov, L.S. Revin, V.A. Shamporov, A.A. Gunbina, L.S. Kuzmin, *Appl. Phys. Lett.*, 110, 162603 (2017).

NOTES:

¹ Institute for Physics of Microstructures of Russian Academy of Sciences, Nizhny Novgorod, Russia, rls@ipmras.ru

² Nizhny Novgorod State Technical University n.a. R.E. Alexeev, Nizhny Novgorod, Russia

³ Lobachevsky Nizhny Novgorod State University, Nizhny Novgorod, Russia

⁴ Chalmers University of Technology, Gothenburg, Sweden