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Towards practical applications of powerful and widely-tunable THz sources made of layered superconductors[1]

HUABING WANG, National Institute for Materials Science (NIMS)

Terahertz (THz) emission from intrinsic Josephson junction stacks made of high temperature superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$ have been obtained both in a low bias and a high bias regime [1, 2]. While at low bias the temperature distribution in the stack is almost homogeneous, at high bias an over-heated part (hot spot area) and a cold part of the sample coexist [2, 3]. Previous resolution-limited measurements indicated that the linewidth Δf of THz emission may be below 1 GHz, showing no difference between two regimes. In this talk, we report on measurements of the linewidth of THz radiation using a Nb/AlN/NbN integrated receiver for detection [4]. While at low bias we found Δf to be not smaller than ~500 MHz, at high bias Δf turned out to be as narrow as a few MHz. We attribute this to the hot spot acting as a synchronizing element. Also thanks to the variable size of the hot spot and the temperature rise due to the self-heating, the emission frequency can be tuned over a wide range of up to 500 GHz. Last but not least, the emission power was measured to be above 25 μW. All these properties imply that THz sources made of layered cuprate superconductors can be employed for practical applications.

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[1]In collaboration with M. Y. Li, J. Yuan, N. Kinev, J. Li, A. Ishii, K. Hirata, T. Hatano, R. G. Mints, S. Guénon, B. Gross, D. Koelle, R. Kleiner, V. P. Koshelets, and P. H. Wu.