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THz Radiation from Mesas of Intrinsic Josephson Junction of $Bi_2Sr_2CaCu_2O_{8+\delta}$ under Extreme Thermal Inhomogeneity[1]

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After the discovery of intense, coherent and continuous electromagnetic waves at terahertz frequencies (THz waves) in 2007,[2] a number of experimental and theoretical works have been carried out to understand the THz radiation phenomena from mesa structure of layered high temperature superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$ (hereafter abbreviated as Bi2212). At present after five year intensive studies, the basic mechanism of the THz wave emission can be understood by two principles: one is the ac-Josephson effect working in-between individual intrinsic Josephson junctions in the mesa of Bi2212 and the other is the cavity resonance effect associated with both the geometrical shape and the electromagnetic properties of the mesa structures of Bi2212. However, the precise conditions to obtain strong THz radiation are not yet established well at the stage of mesa fabrication.[3] Moreover, it appears that our recent results of measurement of the inhomogeneous temperature distribution due to the hot-spot formation producing gigantic Joule heat in the mesa may give us much more complicated situations to understand physics of the THz radiation.[4] In this talk based on the experimental results we will provide a unified picture of the THz radiation phenomena in spite of highly nonequilibrium thermal condition, which hopefully will give us a hint to improve the performance and the efficiency of the emission power exceeding 1 mW from a single mesa structure. This will be also useful for various applications.

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[2]L. Ozyuzer et al.,Science 318 (2007) 1291, Kadowaki et al., Physica C468 (2008) 634.
[3]M. Tsujimoto et al., PRL 108 (2012) 107006.
[4]H. minami et al., submitted to PRL.