Coherent THz-wave emission from voltage- and number-controlled intrinsic Josephson junctions in Bi$_2$Sr$_2$CaCu$_2$O$_{8+\delta}$\(^1\) MAN-ABU TSUJIMOTO, RYO NAKAYAMA, NAOKI ORITA, TAKASHI KOIKE, KOTA DEGUCHI, KAVEH DELFANAZARI, TAKASHI YAMAMOTO, TAKA-NARI KASHIWAGI, HIDETOSHI MINAMI, MASASHI TACHIKI, KAZUO KAD-OWAKI, University of Tsukuba — Intense and coherent terahertz electromagnetic wave (THz-wave) emission from the intrinsic Josephson junctions (IJJs) in single crystalline high-$T_c$ superconductor Bi$_2$Sr$_2$CaCu$_2$O$_{8+\delta}$ (Bi-2212) was reported in 2007 [L. Ozyuzer \textit{et al.}, Science \textbf{318}, (2007) 1291.]. In the present work, we demonstrate the relationship between the bias condition and the resonance state by controlling both the applied voltage, $V$, and the number of resistive junctions, $N$. We directly observed that if $N$ junctions are in resistive state, the resonance frequency, $f_J$, varies in accordance with the ac-Josephson relation: $f_J = (2|e|/h)V/N$, although frequency $f_J$ has previously been thought to be uniquely determined by the geometrical condition due to the cavity resonance effect [M. Tsujimoto \textit{et al.}, Phys. Rev. Lett. \textbf{105}, (2010) 037005.]. We also found that the emission intensity varies as a function of both $f_J$ and $N$.

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