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Filling and Bridging the THz Gap Using High-T_c Superconducting $Bi_2Sr_2CaCu_2O_{8+\square}$ Intrinsic Josephson Junction Emitters

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Generation of terahertz (1 THz=10^{12} c/s) electromagnetic waves with a frequency range of 0.3 – 10 THz in-between microwaves and infrared light in the electromagnetic spectrum has been a long-standing issue in the history of optics and optical science and engineering. Recent rapid progress in information technology over the wide frequency spectrum of the electromagnetic waves has urged researchers for the development of TBit technologies. In addition, the demand for the THz waves has also been grown to overcome first the technological barrier to generate THz waves. During last two decades enormous effort has been made. As a result, semiconductor devices such as RTD or QCL devices have been developed successfully. At present, the out-put power of ~1 μW at 1.42 THz by RTD[1] and 0.36 mW at 1.4 THz by cold QCL at 10 K[2] have been reported. Although the THz gap gets narrower and narrower and the valley becomes shallower and shallower, a great difficulty still lies there and hinders many interesting applications in this frequency range.

A new challenge has been started in 2007 after the discovery of continuous and coherent THz emission was discovered in an intrinsic Josephson mesa device fabricated on the single crystal substrate of high temperature superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$, which is well-known as highly 2D anisotropic layered superconductor. Using multi-stacked Josephson layer property, we could manage to develop THz emission up to 2.4 THz[3].

Just recently, we have successfully made a remarkable improvement on high frequency properties by making a new type of devices. We think that this type of devices may be ultimate conceptually and can be applied in the arrays easily. This progress will be reported in my talk together with the recent work on the applications using algae paramylon and the related carbohydrates such as cellulose, curdlan, etc.

References

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