Abstracts

Optical-microwave interaction modeling in high-temperature superconducting films

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Optical-microwave interaction in high-T/sub c/ superconductors is investigated for performing basic optoelectronic functions in cryogenic environment. A fast bolometric photoresponse in conjunction with the unique electrical properties of high-temperature superconductor (HTS) materials allows us to explore a series of novel optoelectronic devices with low-noise/low-power and high-speed/high-frequency characteristics. After reviewing the HTS photoresponse categories, we describe the fast bolometric photoresponse and its condition with heat transfer analysis. The analytical solution of heat diffusion equation for an HTS strip mounted on a substrate will be presented for three different type of optical sources. Then the effect of optical irradiation will be incorporated in the two-fluid model by thermomodulation concept in order to model the interaction of optical radiation with electrical signal. The current-field relationship and the supercurrent response time are evaluated in the presence of both optical and electrical signals. Our numerical simulations for YBaCuO film demonstrate the possibility of RF harmonic generation when the laser beam is modulated by the RF signal in the presence of dc bias current and RF signal mixing when the HTS film is fed by a time-harmonic microwave source. The developed model can also be used to study optical control and tunability techniques for HTS microwave devices for analog signal processing.

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