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Optimizing Detection Methods for THz Bio-imaging Applications

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Abstract : A new approach for efficient detection of THz radiation in biomedical imaging applications is proposed. A double-layered absorber consisting of a 32 nm thick aluminum (Al) metallic layer, located on a glass medium (SiO2) of 1 mm thickness, was fabricated and used to design a fine-tuned absorber through a theoretical and finite element modeling process. The results indicate that the proposed low-cost, double-layered absorber can be tuned based on the metal layer sheet resistance and the thickness of various glass media taking advantage of the diversity of the absorption of the metal films in the desired THz domain (6 to 10 THz). It was found that the composite absorber could absorb up to 86% (a percentage exceeding the 50%, previously shown to be the highest achievable when using single thin metal layer) and reflect less than 1% of the incident THz power. This approach will enable monitoring of the transmission coefficient (THz transmission ''fingerprint'') of the biosample with high accuracy, while also making the proposed double-layered absorber a good candidate for a microbolometer pixel's active element. Based on the aforementioned promising results, a more sophisticated and effective double-layered absorber is under development. The glass medium has been substituted by diluted poly-si and the results were twofold: An absorption factor of 96% was reached and high TCR properties acquired. In addition, a generalization of these results and properties over the active frequency spectrum was achieved. Specifically, through the development of a theoretical equation having as input any arbitrary frequency in the IR spectrum (0.3 to 405.4 THz) and as output the appropriate thickness of the poly-si medium, the double-layered absorber retains the ability to absorb the 96% and reflects less than 1% of the incident power. As a result, through that post-optimization process and the spread spectrum frequency adjustment, the microbolometer detector efficiency could be further improved.

Keywords : bio-imaging, fine-tuned absorber, fingerprint, microbolometer
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