

## How effectively do carbon nanotube inclusions contribute to the electromagnetic performance of a composite material? Estimation criteria from microwave and terahertz measurements

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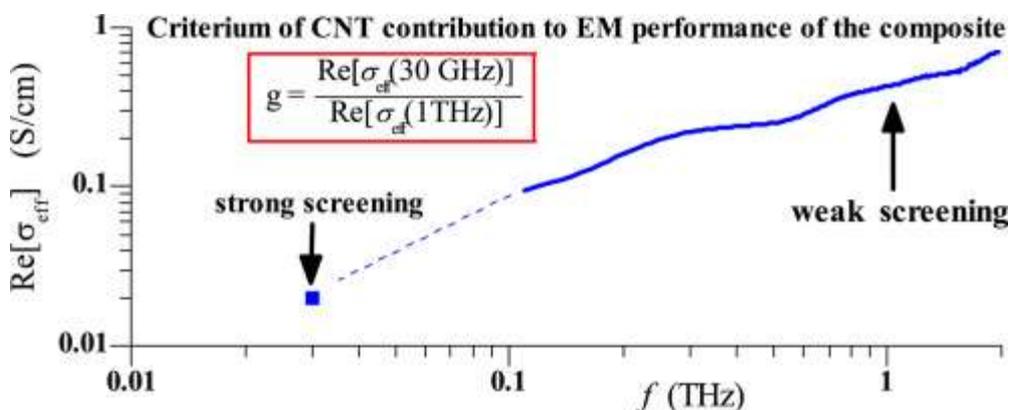
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### Abstract:

Screening effect in finite-length carbon nanotubes (CNT) and their agglomerates hinders significantly the electromagnetic interaction in composite materials. Screening effect is strong in the microwave range, and it decreases with increasing frequency resulting in a strong frequency dependence of the effective conductivity of the composite. Since screening effect is rather small in the terahertz range, the effective conductivity in this range is determined directly by the intrinsic conductivity of the inclusions. The ratio of the microwave to terahertz effective conductivities was proposed as a parameter to estimate how effectively carbon nanotube inclusions contribute to the electromagnetic performance of composite materials in the microwave range. CNT film was considered as a material where maximal possible interaction of the CNTs with EM field occurs. Single-walled CNT films and CNT-based composite materials, as well as hybrid film comprising mixtures of WS<sub>2</sub> nanotubes and CNTs were fabricated and measured in the microwave and terahertz ranges. The electromagnetic field interaction with the inclusions has been estimated for all the samples fabricated.



### Keywords:

electromagnetic interaction, carbon nanotubes, composite materials, microwave and terahertz