Thermal characterization of composites and layered systems: Challenges and opportunities

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One of the most challenging areas in material science involves the management and control of heat transfer, being the basis of numerous ongoing and emerging technological applications. Composites and layered materials constitute the core of a broad variety of high-performance systems, which are in the vanguard to face the high and increasing demand of new and more efficient devices, machines, and instruments. Photothermal techniques are well-established methodologies, with the capability to address the study of this kind of systems and having the flexibility to perform reliable analyses at a broad range of scales [1]. We present results on the study of heat transfer of a variety of composites and layered systems, aimed at showing the capacity of the photothermal techniques in supporting the study of complex systems and processes. Our studies involve polymers, phase changing materials, as well as composites formed by filler in matrices, as well as multilayered systems. Strategies for increasing, in a controlled form, the thermal conductivity in composites are presented. In the case of matrices with fillers, the factors defining the development of high thermal conductivity composites, the role of the form, distribution, geometry and connectivity of the phases, and the key role of the thermal interfacial resistance is discussed. In particular, the possibility of observing thermal percolation in this kind of systems is addressed [2]. The development of novel configurations and methodologies, aimed at surmounting the inherent restrictions, associated with the study of heat transfer in these systems, is discussed. Additionally, the limitations established by the thermal diffusion length in the study of heat transfer as well as methodologies to face these constraints are described [3].

References

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