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On the heat transfer through a solid slab heated uniformly and continuously on one of its surfaces

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Abstract

Some peculiarities of the heat transfer through a sample that is heated by the superficial absorption of light energy under continuous uniform illumination are discussed. We explain, using a different approach to that presented in a recent article published in this journal (Salazar *et al* 2010 *Eur. J. Phys.* **31** 1053–9), that the front surface of a thick sample reaches a higher equilibrium temperature than a thin one, a fact that may be against some people's first intuition. From the analytical solution of the problem, we obtain a condition necessary to apply a very thermally thin sample approximation, i.e. to neglect a temperature gradient across a sample. From the analysis of the heat transfer through both a thermally thin and a thermally thick sample, we suggest an inexpensive experiment suitable for measuring the thermal diffusivity of low thermal conductivity solids. Both the theoretical analysis and the suggested experiment can be suitable for students and teachers dealing with heat transfer problems, thermal characterization techniques and/or partial differential equations at undergraduate and graduate levels.

1. Introduction

Although mankind's experience of heat propagation dates from ancient times, and even though the mathematical foundations of the heat transfer phenomena were established more than 150 years ago with the early works of Fourier [1], there are still several misconceptions and erroneous interpretations of the phenomena appearing often in daily life and scientific research.

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