Photoacoustic Spectroscopy: An Enhancement Of The Photoacoustic Signal And Its Analysis From The Perspective Of Heat Generation

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Photoacoustic spectroscopy (PAS) is a powerful technique to investigate semiconducting samples and determine some of their basic properties e.g., energy gap [1], thermal conductivity [2] and thermal diffusivity [1, 3]. Most importantly, the PAS technique does not require special preparation of samples. Using this method, it is possible to measure samples that are difficult to study by conventional absorption/transmission techniques due to high scattering of light, opaqueness, or the state of the sample, i.e., powdered/liquid form [4 – 6]. These advantages are because, in PAS, sound is detected instead of light. Moreover, this also means that the sensitivity of this method does not vary with the spectral range due to the requirements of using different photodetectors. However, just like any measurement technique, PAS also has limitations. One of them is signal saturation, which causes difficulties in investigating some of the properties of studied samples. Hence, one of the goals is to improve the sensitivity of PAS. Due to above, in this work we focus on enhancing photoacoustic (PA) signal intensity in a non-complex way, which does not require changing any part of a measurement setup. We show how to improve sensitivity in this technique, mainly by manipulating the sample volume and its environment. Moreover, we show a simple model that we proposed to describe and explain obtained results in thermal terms. Additionally, we present how to correctly determine an energy gap based on the PA measurement since there is no consensus in this aspect, and so far, in many articles this parameter is obtained in different ways depending on investigated materials.

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