

# Photothermal conversion for the solar energy use

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**A. Rojas<sup>2</sup>, R. C. García-Zuñiga<sup>1</sup>, A. Colin-Vidal<sup>1</sup>, U. Nogal<sup>2</sup>, J. Hernández-Wong<sup>2</sup>, M. Aguilar-Frutis<sup>1</sup>, R. A. Muñoz-Hernández<sup>1</sup>, E. Marín<sup>1</sup>, A. Calderón<sup>1</sup>**

<sup>1</sup> Instituto Politécnico Nacional. Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada. Unidad Legaria. Legaria 694 Colonia Irrigación, 11500 Ciudad de México.

<sup>2</sup> CONAHCyT-Instituto Politécnico Nacional, Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada, Legaria 694, Col. Irrigación, 11500 Ciudad de México, México.

**E-mail:** jcalderona@ipn.mx (A. Calderón)

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## Abstract

This work describes the mechanisms of photothermal conversion and related concepts, avoiding, as far as possible, technicalities and advanced mathematical language to make it accessible to students and professionals from diverse fields and not only to people related to science and engineering. Some of most critical applications in the field of photothermal conversion are discussed. However, the article is focused on the use of solar energy. Initially, some basic concepts are presented that are necessary to achieve a more precise description of the main topic, which is discussed in the final part of the article: the photothermal conversion mechanisms and their application in solar thermal energy. We consider this a topic of growing interest in the field of renewable energies that, due to its current relevance, is pertinent to widely disseminate and promote its understanding among students and professionals interested in knowing about this important field of knowledge.

**Keywords:** Photothermal conversion; solar energy; thermal radiation; optical absorption.

## Resumen

Este trabajo describe los mecanismos de conversión fototérmica y conceptos relacionados evitando, en lo posible, tecnicismos y un lenguaje matemático avanzado para hacerlo accesible a estudiantes y profesionales de campos diversos y no solo a personas relacionadas con la ciencia y la ingeniería. Se comentan algunas de las más importantes aplicaciones del campo de la conversión fototérmica, sin embargo, el artículo está enfocado hacia la del aprovechamiento de la energía solar. Inicialmente se presentan algunos conceptos básicos que son necesarios para lograr una descripción más clara del tema principal, que se trata en la parte final del artículo, los mecanismos de conversión fototérmica y su aplicación en el campo de la energía solar térmica. Consideramos que este es un tema de interés creciente en el campo de las energías renovables que, por su actual relevancia, es pertinente dar una amplia divulgación y fomentar su comprensión en estudiantes y profesionales interesados en conocer sobre este importante campo del conocimiento.

**Palabras clave:** Conversión fototérmica; energía solar; radiación térmica; absorción óptica.

For economic, environmental, and political reasons, it is necessary to look for alternative energy sources to fossil fuels, which are at the same time economical, abundant, clean, and preserve the ecological balance [Arutynov, 2017]. Energy from the sun, wind, and the Earth (geothermal) are the options. However, energy from the sun has extra advantages, and it is the most promising alternative. The sun emits energy 24 hours a day and 365 days a year; all places receive this energy according to their location (latitude); it is abundant and accessible, it is non-polluting, it does not produce harmful waste, it occupies less area per watt in the energy production, no one can increase its price, etc. [Gong, 2019]. The use of solar energy is widely justified if the statistical data related to the radiation incident in the Earth's atmosphere is observed, with a solar constant of  $1,367 \text{ W/m}^2$  and an energy of  $2.16 \times 10^{20} \text{ W/h/year}$  [Duffie, 2013].

Photothermal (PT) conversion refers to the process of converting light energy into heat. This conversion is typically achieved using materials that can absorb light and transform it into thermal energy. The absorbed light energy raises the temperature of the material, leading to an increase in its thermal energy. PT conversion efficiency depends on the material properties and the wavelength of the incident light. Materials with high absorption coefficients in the desired spectral range are often chosen for effective PT conversion. In various applications, PT conversion is utilized for different purposes, including Solar Energy Harvesting, PT Therapy, Water Purification, and Heat-Assisted Magnetic Recording (HAMR), which will be discussed later. Before giving an explanation of the mechanisms of photothermal conversion of sunlight, we will present some concepts necessary for their description.