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Editorial

New Frontiers in Novel Optical Materials and Devices

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Optical materials can be defined as materials that are used to alter and control electromagnetic radiation in the ultraviolet, visible or infrared spectral regions [1]. Optical materials and devices have a rich history, and this research field has attracted the interest of many researchers and provided tools for major developments. The ancient Greeks were the first to establish optics as a theory of vision and use optical devices such as mirrors and lenses. Johannes Kepler (1571–1630) developed the theory of optical images, which is the basis of modern geometrical optics, and was able to understand the principles of the famous optical instrument developed by Galileo Galilei (1564–1642)—the telescope [2]. Since then, most major developments in physics have had a great impact on the field of optics, allowing for the development of new material and devices. A sign of the continuing relevance of this field, despite its long tradition, is the fact that 3.4% of all Nobel Prizes in science categories awarded between 1995 and 2017 were for the disciplines of optoelectronics and photonics [3]. Younger disciplines, such as particle physics and atomic physics account for 14% and 10.9%, respectively. These disciplines are the most rewarded in the field of physics, and their findings are able to inspire new develops in optics fields [4].

Optical material and devices play a major role in areas such as the biomedical devices, imaging, optical communications networks, optical storage media or photovoltaics [5,6]. Among optical materials, it is possible to find impurity-doped dielectric crystals, semiconductors, ceramics, glasses, polymers, rare-earth doped materials, and nano-based composites. These materials are used for several applications: to fabricate devices with specific transmission, reflection, and absorption properties; to transmit information; and for sensing applications and energy conversion, just to name a few. Among the most relevant properties of optical materials, which must be considered depending on their specific applications, are the degree of transparency and refractive index as a function of the wavelength, uniformity, strength and hardness of the material, temperature limits, hygroscopic nature, and chemical resistivity [1].

Nonlinear optical materials are materials whose optical properties depend on the intensity of the incident light [7] and have particularly useful properties for applications in optical communications and signal processing, laser medicine, parallel imaging processing, or integrated optics [8–10].

Theoretical and computational modeling are fundamental strategies for understanding and predicting the properties of optical materials, paving the way to modify their properties and improve their performance, leading to the development of new applications [11].

Despite the huge number of studies already reported in the field of optical material and devices, research on these topics shows no sign of slowing down, in terms of both the number of studies and their phenomenal impact, as demonstrated by the number of articles published in the most impactful journals [12–14].

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