

Photon managements by employing nanostructures for optoelectronic devices

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It is of current interest to develop the photon management with nanostructures since the ability to suppress the reflection and light trapping over a broad range of wavelengths and incident angles plays an important role in the performance of optoelectronic devices, such as photodetectors, light-emitting diodes, optical components, or photovoltaic systems. Superior light-trapping characteristics of nanowires, including polarization-insensitivity, omnidirectionality, and broadband working ranges are demonstrated in this study. These advantages are mainly attributed to the subwavelength dimensions of the nanowires, which makes the nanostructures behave like an effective homogeneous medium with continuous gradient of refraction index, significantly reducing the reflection through destructive interferences. The relation between the geometrical configurations of nanostructures and the light-trapping characteristics is discussed. We also demonstrated their applications in solar cells and photodetectors. This research paves the way to optimize the nanostructured optoelectronic devices with efficient light management by controlling structure profile of nanostructures.

Bio

Dr. Jr-Hau He is an Associate Professor of Electrical Engineering at King Abdullah University of Science & Technology (KAUST). He was a Visiting Scholar at Georgia Tech (2005), a Postdoc Fellow at National Tsing Hua University (2006) and Georgia Tech (2007), a Visiting Professor at Georgia Tech (2008), UC Berkeley (2010 and 2014), and UC San Diego (2012-2013), and HKPolyU (Dec. of 2014), and a tenured Associate Professor at National Taiwan University (2007-2014).

His work encompasses a broad, multidisciplinary field, borrowing from electrical, physics, chemical and materials science and engineering to understand the effects of nanomaterials on the performance of advanced devices. He devotes his efforts in the development of transparent and flexible electronics using novel devices based on nanomaterials, including solar cells and photodetectors, LEDs, and memory devices. He is also interested in harsh electronics. His particular interest in solar energy include efforts to understand light scattering and trapping in nanostructured materials and designs for next-generation solar cells. He is also interested in transport of charge carriers across these solar cells as well as the improvement in light coupling with the combined effect to increase the efficiency of separating the photoinduced charges. Dr. He's group is also currently involving in fundamental physical properties of nanomaterials, such as the transport and switching behavior of 2D nanomaterials. He emphasizes the transfer of the nanotechnology he developed to semiconductor and PV industry. Dr. He served as Accreditation Council of "Republic of China fine manufacturer association" to advise small and medium-sized enterprises to have innovation and product features in the marketplace.

He has garnered over 5878 citations for a body of work consisted of ~140 peer reviewed journal articles with 32 of H factor over his career and over 200 presentations in international conferences. His breakthrough researches have been highlighted over 50 times by various scientific magazines such as Nature, SPIE newsroom, IEEE SPECTRUM, EE Times, Semiconductor Today, Materials Today, Chemical & Engineering News, and Nano Today.

He participates actively in activities and services in scientific professional societies. Professor Jr-Hau He has been recognized internationally. He serves as a member of the editorial board for numerous prestigious journals, and as a chair, co-chair, and a member of technical and steering committees for national and international symposiums. He is a recipient of Ta-You Wu Memorial Award (2014), Outstanding Young Electrical Engineer Award by Chinese Institute of Electrical Engineering (2013), Outstanding Youth Award of Taiwan Association for Coating and Thin Film Technology (2012), Youth Optical Engineering Medal of Taiwan Photonics Society (2011), Distinguished Young Researcher Award of the Electronic Devices and Materials Association (2011), Prof. Jiang Novel Materials Youth Prize of International Union of Pure and Applied Chemistry (IUPAC) (2011), and the Exploration Research Award of Pan Wen Yuan Foundation (2008) and selected as a Member of the Global Young Academy (2011). He is a senior member of IEEE, OSA, and SPIE. The laboratory has graduated 7 PhD and 24 MS alumni to date. Visit his web for more information (nanoenergy.kaust.edu.sa).

何志浩目前為沙烏地阿拉伯 KAUST 電機副教授。其研究領域是太陽能電池（包含水分解的應用）、光偵測器、與發光二極體之光管理，神經形態工程 (Neuromorphic engineering)，二維材料之光電元件與電晶體。這幾年基於過去的基礎，研究興趣延伸至紙印刷電子學，可撓式/透明電子元件。何志浩教授在國際核心專業期刊發表約 150 篇，被引用超過 5400 次，H factor 為 34。七篇高引用度文章 (**highly cited papers of Essential Science Indicators**)、獲得 9 個期刊封面、近 50 次的國際會議邀請報告、近 60 次的國際新聞報導也讓何志浩團隊的研究工作引起高度注目。何教授領導之研究團隊也在專業學會與會議得超過 30 個獎項，獲得國際上的肯定。除了科學研究之外，何志浩教授對技術工業化相當重視，積極參與產學合作、持續技術轉移給工業界。曾獲得吳大猷獎(2014)、中國電機工程學會優秀青年電機工程師獎 (2013)、台灣鍍膜科技協會傑出青年獎(2012)、中華民國光電學會第一屆青年光電工程獎(2011)、臺灣電子材料與元件協會傑出青年獎 (2011)、 Prof. Jiang Novel Materials Youth Prize of International Union of Pure and Applied Chemistry (IUPAC) (2011)與潘文淵基金會考察研究獎(2008) 以及獲選為 Member of the Global Young Academy (2011)。何志浩老師為 IEEE, OSA, and SPIE 資深會員。更多研究相關，請連結何志浩老師實驗室: nanoenergy.kaust.edu.sa。