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# **Structure-Property Relationships in Organic Photovoltaics: From Molecular Design to Niche Applications**

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### Abstract

Owing to the advancement in new material design over the past few years, the power conversion efficiencies (PCE) of organic photovoltaics (OPV) have now reached over 17% for both singlejunction and multi-junction devices [1,2]. However, in order to meet the commercialization requirement, further improvement in device efficiency, stability, and the exploration of niche applications of OPVs are urgently needed. In this talk, I will first discuss how to utilize an integrated strategy combining material design, interface engineering and optical management to tackle the efficiency and stability challenges of OPVs. I will first reveal the structure-property relationships of the state-of-the-art OPVs based on new acceptor molecule (Y6), showing that the special molecular packing of the acceptor is the key reason for its exceptional photovoltaic property [3]. Second, I will highlight our work on using optical management as a powerful means to enhance the performance of OPVs by maximizing the light harvesting property of the devices. I will discuss how to apply high throughput optical model to rapidly screen more than 10 million device structures in order to identify the very best device design for extremely high performance tandem [2,4] and semitransparent(ST)-OPVs [5]. In addition, I will talk about how to engineer the optical property of ST-OPV for smart greenhouse applications, [6] as well as the design of ST-OPV with both heat insulation and power generation functions [7]. Finally, I will discuss possible strategies for enhancing the operation lifetime of OPVs to over 20 years [8] and also discuss our recent progress on OPV module development.

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## **Biography of Presenting Author**



**Hin-Lap Yip** joined the Department of Materials Science and Engineering and School of Energy and Environment at City University of Hong Kong as Professor in 2021. From 2013-2020, he was a Professor in the State Key Laboratory of Luminescent Materials and Devices (SKLLMD) and the School of Materials Science and Engineering (MSE) in South China University of Technology (SCUT). He got his BSc (2001) and MPhil (2003) degrees in Materials Science from the Chinese University of Hong Kong (CUHK), and completed his PhD degree in MSE in 2008 at the University of Washington (UW), Seattle. His research focuses on the use of an integrated approach combining materials, interface, and device engineering to improve both

polymer and perovskite optoelectronic devices. He had published more than 220 scientific papers with citations over 25000 and a H-index of 81. He was also honored as ESI "Highly Cited Researcher" for 7 times from 2014-2020. He was a co-founder of Soluxra, LLC (2010-2018). In 2018, He was appointed as the Director for the Innovation Center for Printed Organic Photovoltaics in Dongguan, which focuses on translational research and commercialization of new generation photovoltaic technology. He currently serves as an editorial board member of *Science Bulletin* and *Journal of Semiconductors*, and international advisory board member for *Matter*.

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