Advancing Interferometric Quantitative Phase Microscopy towards Femtometer-level Measurement Accuracy

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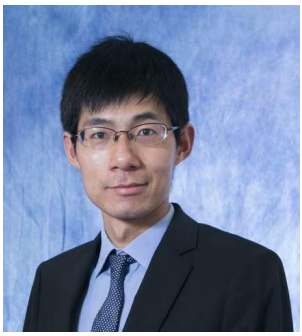
Interferometric quantitative phase microscopy (iQPM) is a promising technique for nanometrology by offering high measurement accuracy. I will first introduce recent advances in iQPM and their applications in the characterization of micro- and nano-structures. Then, I will present our results on pushing the phase sensitivity limit of iQPM to ~2 picometers in optical path delay, which laid the foundation for developing quantitative phase profilometry that can precisely map the thickness maps of single-layer 2D materials. After that, I will show our latest work on pushing the measurement accuracy limit of iQPM to the femtometer-level by utilizing a novel phase amplification mechanism, thus bypassing the conventional phase noise limits. We mapped the interlayer spacing difference between bilayer graphene samples with different twisting configurations, which cannot be probed in situ by existing techniques. With such unprecedented accuracy, iQPM is expected to expedite wafer-scale atomic fabrication as well as probing subatomic phenomena in quantum materials.



Short Bio:

Renjie Zhou is an Associate Professor in the Department of Biomedical Engineering at CUHK, where he directs Laser Metrology and Biomedicine (LAMB) Laboratory. He received a PhD degree in Electrical and Computer Engineering from the University of Illinois at Urbana-Champaign in 2014, followed by a postdoctoral training at MIT before joining CUHK in 2017. His research interest is mainly in quantitative phase imaging and optical diffraction tomography and their applications. He has published > 60 journal papers, including Nature Photonics, Light: Science & Applications, Advanced Photonics, Lasers & Photonics Review as the

first/corresponding author, as well as filed > 10 International/US/China patents with several licensed to industry. He has been involved in organizing >20 international conferences as co-chairs/committee members, delivered >40 conference invited talks and seminars / co-lloquiums, and reviewed >30 international journals. He is currently serving on the editorial boards of JOSA A, IEEE Photonics Technology Letters, and International Journal of Extreme Manufacturing. During 2023-2024, he served as the Assistant Dean (Research) of the Faculty of Engineering at CUHK. He is a Senior Member of Optica and SPIE. He received the Croucher Innovation Awards in 2019 from the Croucher Foundation and the Excellent Young Scientists Fund from National Natural Science Foundation of China in 2024.