CV for **Hon Ki TSANG,** Fellow of IEEE, Fellow of Optica

Wei Lun Professor of Electronic Engineering and Dean of the Faculty of Engineering
The Chinese University of Hong Kong

E-mail: hktsang@ee.cuhk.edu.hk;

EDUCATION

1991 PhD, University of Cambridge.
Thesis title: "Optical Nonlinearities in Quantum Well Waveguides"
1987 BA Honours, University of Cambridge (1991 MA, University of Cambridge)
Engineering part I (for Electrical, Mechanical and Civil Engineering), and
Electrical and Information Sciences Tripos;

Career Summary

5/24 to now	Dean, Faculty of Engineering, CUHK
8/23-4/24	Interim Dean, Faculty of Engineering, CUHK
2022-now	Wei Lun Professor of Electronic Engineering, CUHK
2018-2023	Associate Dean (Research) of Faculty of Engineering, CUHK
2010-16	Chairman, Department of Electronic Engineering, CUHK
2003-now	Professor, CUHK
2001-03	Director, Product Group Head, Bookham Technology plc (Oxfordshire, UK)
1996-2001	Associate Professor, CUHK
1993-1996	Lecturer (academic title of Assistant Professor introduced in 1994), CUHK
1991-1993	SERC Research Fellow, School of Physics, University of Bath (UK)
1990-1991	Visiting Researcher (8 months), Bell Communications Research, (NJ, USA)
1984-1990	Student at University of Cambridge (BA and PhD)
1983-1984	Full time Trainee, GEC Telecommunications plc (Coventry, UK)

Research Activities

(keywords: Silicon Photonics; Optical Communications; Photonic Integrated Circuits; optical waveguide devices; Optical modulators; optical coherence tomography; 2D materials)
H-index 46 (SCI); 51 (Scopus); 56 (Google), ORCID: https://orcid.org/0000-0003-2777-1537
Google: https://scholar.google.com/citations?hl=en&user=PhSv958AAAAJ

I have worked on silicon photonics since 2001. In 2001-03, I took leave from CUHK to work at Bookham Technology plc as an executive director leading the team which developed the multi-channel silicon variable optical attenuator and the multiplexer-VOA products The EVOA was deployed in the metropolitan area telecommunication networks. My CUHK academic research in silicon photonics include the first experimental studies of the Kerr nonlinearity, two photon absorption and related free carrier absorption in silicon waveguides which led to improved understanding on the nonlinear limitations of silicon waveguide.. My experience in industry showed the critical challenge and importance of low coupling losses, ideally below 1dB, for the fiber to silicon waveguide interfaces. I started research on advanced waveguide grating couplers in 2008. Examples of my research contributions on this topic include:

(1) Subwavelength Engineering in Waveguide Grating Couplers

(i) The first experimental realization of nano-hole subwavelength engineered gratings, designed using the effective medium theory formulated by S.M. Rytov in 1956.

"Nanoholes grating couplers for coupling between silicon-on-insulator waveguides and optical fibers," IEEE Photonics Journal 1, p.184-190, 2009 (cited 113 times).

(ii) The first proposal and demonstration of the use of the birefringence of subwavelength grating to compensate waveguide birefringence for making polarization independent grating couplers :

"Polarization-independent grating couplers for silicon-on-insulator nanophotonic waveguides,"Optics Letters 36 (6), 796-798, 2011 (cited 209 times).

(iii)Reducing the average refractive index of the grating region and thereby enhance the operating optical bandwidth of grating couplers using subwavelength grating:

"Wideband subwavelength gratings for coupling between silicon-on-insulator waveguides and optical fibers," Optics Letters 37 (17), 3483-3485, 2012. (cited 109 times)

(iv)The development of focusing through-etched sub-wavelength gratings for mid-infrared membrane waveguides with the advantages of compact size, higher efficiency and wider operating bandwidths:

"Focusing subwavelength grating coupler for mid-infrared suspended membrane waveguide," Optics Letters 37 (7), 1217-1219, 2012. (cited 111 times); "Broadband focusing grating couplers for suspended-membrane waveguides," Optics Letters 37 (24), 5181-5183, 2012. (cited 65 times); "Apodized focusing subwavelength grating couplers for suspended membrane waveguides," Applied Physics Letters 101 (10), 101104, 2012. (cited 78 times); "Experimental demonstration of polarization-insensitive air-cladding grating couplers for silicon-on-insulator waveguides," Optics Letters 39 (7), 2206-2209, 2014. (cited 96 times); "Focusing subwavelength grating coupler for mid-infrared suspended membrane germanium waveguides," Optics Letters 42 (11), 2094-2097, 2017. (cited 99 times)

(v) The application of subwavelength engineered grating couplers for dual band operation: "Tailorable dual-wavelength-band coupling in a transverse-electric-mode focusing subwavelength grating coupler," Optics Letters 43 (12), 2985-2988, 2018. (cited 37 times)

(2) **High coupling efficiency grating couplers**

(i) First demonstration of duty-cycle apodization for high coupling efficiency grating coupler to reduce coupling loss to 1.2dB:

"Apodized waveguide grating couplers for efficient coupling to optical fiber," IEEE PTL, 22 (15), 1156-1158, 2010. (cited 314 times)

(ii) Proposal and demonstration of shifted polysilicon overlay grating to improve coupling efficiency and demonstration of its use to reduce coupling loss to as low as 0.89dB for single mode fiber with a robust, photolithography-patterned (feature size>180nm) nanostructure

"Photolithography Fabricated Sub-Decibel High-Efficiency Silicon Waveguide Grating Coupler," IEEE Photonics Technology Letters 35 (1), 43-46, 2023. (cited 13 times); "Optimized shift-pattern overlay for high coupling efficiency waveguide grating couplers," Optics Letters 47 (15), 3968-3971, 2022. ; "High coupling efficiency waveguide grating couplers on lithium niobate," Opt. Lett. 48, 3267-3270, 2023. "High efficiency multimode waveguide grating coupler for few-mode fibers," IEEE Photonics Journal 14, 1-5, 2022.

(iii) Application of shift-pattern overlay to improve coupling efficiency and engineer polarization independence:

"Polarization-independent waveguide grating coupler using an optimized polysilicon overlay," Optics Letters 47 (22), 5825-5828, 2022.

3. Multimode waveguide grating couplersfor mode-division multiplexing

"Efficient mode multiplexer for few-mode fibers using integrated silicon-on-insulator waveguide grating coupler," IEEE Journal of Quantum Electronics 56 (1), article 8400107, 2020. (cited 60 times); "Multi-chip multidimensional quantum network with entanglement self-retrieving," Science, 2023 (cited 21 times); "Nonparaxial mode-size converter using an ultracompact metamaterial Mikaelian lens," Journal of Lightwave Technology 39 (7), 2077-2083, 2020. "Dynamic Control of Distal Spatial Mode Pattern Output From Multimode Fiber Using Integrated Coherent Network," IEEE Photonics Journal, vol. 15, no. 5, Art no. 6602205, 2023. [2 citations];US Patent # 11048045 "Integrated Lens Mode Size Converter; US patent # 11428869 "Multimode Waveguide Grating Coupler"

4.Mirror symmetry gratings using resonance-enhancement to achieve>120nm 1dB bandwidth

"Photolithography Fabricated Broadband Waveguide Grating Couplers With 1 dB Bandwidth Over 100 nm," IEEE Photonics Journal, vol. 16, no. 1, Art no. 6600206, 2024.; "Resonance-Enhanced Wideband Grating for Efficient Perfectly Vertical Coupling," IEEE Photonics Technology Letters 36 (8), 555-558, 2024. ; US Patent # 12001054 "Wideband Grating Coupler" granted 2024.

Apart from waveguide grating couplers we have made other significant contributions with highly cited papers on nonlinear silicon photonics and hybrid integration of 2D materials (see google scholar). Recently we have also advanced the state-of-the art of silicon photonics modulators, achieving some of the highest single wavelength data rates with a record 300Gb/s. We are also developing promising approach to use silicon photonics to transmit many data lanes at a single wavelength by using different spatial modes in multimode fiber . This work is funded by a ~10 million ITF grant on using silicon photonics and may enable the growth of high-capacity optical communications in data centers to support the continuing rise in internet data traffic. Our work on high resolution broadband integrated spectrometers is promising for use in high-speed dynamic optical coherence tomography.

Partial List of Invited, Keynote and Plenary talks

"Silicon Photonics for high capacity optical interconnects", **Keynote** at Photonics North, Vancouver May 2024.

"Advances in silicon photonics for high-capacity optical interconnects," **Invited Talk** at European Optical Society Annual Meeting (EOSAM 2023), Dijon, France, 14 September 2023.

"High Q Multimode Racetrack Resonators for integrated Silicon Raman Lasers" **Keynote talk** at Conference on Information Optics and Photonics, Xi'an 2023.

"Silicon Photonics for spectroscopy and imaging" **Invited** talk at International Symposium on Silicon Based Optoelectronics, Fuyang, Zhejiang July 2023.

"Silicon Photonics for Spectroscopic Sensing and Imaging," **Plenary Talk** at 9th Asia Pacific Optical Sensors Conference, Tianjin, June 2023

"Recent Progress on Silicon Photonics for High-Capacity Optical Fiber Interconnects" Invited talk at CLEO, 7th May 2023 San Jose, CA.

"Silicon Photonics Applications and Some Recent Advances," **Plenary Talk** at Optics & Photonics Taiwan International Conference (OPTIC), Kaohsiung, 3rd December 2021

"Silicon Photonics for Spatial-Division Multiplexing and Advanced Optical Transceivers," IEEE International Conference on Solid-State Circuits (ISSCC 2021), **Invited Talk** at Forum 6 (F6): Optical and Electrical Transceivers for 400GbE and Beyond, (online presentation) 2021. https://ieeexplore.ieee.org/document/9365982

"Bound states in the continuum for photonic integration and InP membranes for heralded single photon generation" SPIE Photonics Europe Strasbourg 2020 (**Invited Talk**, Online Presentation archived at https://doi.org/10.1117/12.2558401) ;