香港中文大學
院士講座系列

The 15th Lecture Series by Academicians from the Chinese Academy of Sciences (CAS)

Jointly Organized by
Department of Physics
China Engagement Office

Speaker: **Prof. XU Hongxing**
Division of Mathematics and Physics
Chinese Academy of Sciences
中國科學院數學物理學部徐紅星院士

Title: **Optical Smart Manufacturing Driven by New Quality Productive Forces: Technological Breakthroughs and Industrial Transformation**
新質生產力驅動下的光智造：技術革新與產業賦能

Language: **Putonghua**

Date: **Tuesday, 1 April 2025**
Time: **16:00 – 17:30**
Venue: **LT2, Yasumoto International Academic Park**
Registration: **https://www.cuhk.edu.hk/cneo/cas_2025/**

Biography

Ph.D. from Chalmers Univ. of Technology, Sweden.
Former positions: Asst. Prof. at Lund Univ. (Sweden), Researcher at Chinese Acad. of Sciences, Prof. at Wuhan Univ., Dean of Wuhan Univ. School of Microelectronics.
Current position: President of Henan Acad. of Sciences. Elected CAS Academician in 2017. Elected TWAS Academician in 2018.
Research areas: Plasmonics, molecular spectroscopy, nano-optics.
Key findings: Huge EM field enhancement in nanogaps of paired metal NPs under light, fundamental for single - molecule SERS and related nanogap - based studies. Proposed unified theories on plasmonic forces, single - molecule trapping, SERS & SEF; discovered nano - antenna effect in surface - enhanced spectroscopy; developed tip - enhanced Raman system; realized plasmonic catalysis.

Abstract

Laser technology, with its **monochromaticity, high directionality, and ultrahigh energy density**, has emerged as a pivotal tool in modern precision manufacturing and quantum communications. Today, amid the rapid rise of new quality productive forces characterized by digitalization, intelligentization, and green transformation, intelligent optical manufacturing (**"Optical Smart Manufacturing"**)—strategically integrating photonics, materials science, and information technology—has become a cornerstone for overcoming traditional manufacturing limitations and fostering emerging industries. By "replacing blades with light beams," "manipulating matter through photonic control," and "infusing intelligence via optical sensing," this technology demonstrates unparalleled advantages in high-precision processing, low-carbon production, and flexible manufacturing.

The synergy between lasers and artificial intelligence is accelerating industrial applications across high-end manufacturing value chains: from **laser-drilled cooling film holes in aerospace thermal components**, to ultrafast laser cutting of battery electrodes for renewable energy systems, and extreme ultraviolet (EUV) light sources for advanced lithography machines, laser-based processes are redefining traditional manufacturing boundaries.

In quantum technology, lasers serve as "**optical tweezers**" for manipulating cold atoms for artificial quantum states. Laser-cooled atomic systems enable high-fidelity qubits for quantum computing, while quantum key distribution (QKD) leverages laser-generated single photons to establish ultra-secure communication networks. The deep integration of lasers with quantum engineering is reshaping the future of information technology.

In the future, intelligent optical manufacturing will converge photonics, quantum engineering, and AI to create **self-perceptive, self-adaptive optical manufacturing systems**. To realize this vision, we advocate building interdisciplinary platforms, advancing breakthroughs in core technologies, and cultivating multidisciplinary talents integrating optics, mechanics, electronics, and computing. We anticipate strengthened collaboration between mainland and Hong Kong research teams, leveraging the innovation ecosystem of the Greater Bay Area to position China at the forefront of global leadership in optical manufacturing.

ALL ARE WELCOME