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Min Gu

Min Gu, an Australian Laureate Fellow of the Australian Research Council and a University Distinguished Professor in Optoelectronics, is a Node Director of CUDOS and the Director of the Centre of Micro-Photonics (CMP) at Swinburne University of Technology. His research interests include nanophotonics and biophotonics with internationally renowned expertise in photonic crystals, optical data storage, optical endoscopy, and multi-dimensional optical data storage. Professor Gu is a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE) and the Australian Academy of Science (AAS).

He is also a Fellow of the Australian Institute of Physics (FAIP), the Optical Society of America (FOSA), the International Society for Optical Engineering (SPIE), the Institute of Physics (IOP) and a Senior Member of International Institute of Electric and Electronic Engineers (IEEE). He is a sole author of two standard reference books, Principles of Three-Dimensional Imaging in Confocal Microscopes (World Scientific, 1996) and Advanced Optical Imaging Theory (Springer-Verlag, 2000). He is also the first author of the book published by Cambridge University Press (Femtosecond Biophotonics: Core Techniques and Applications, 2010). Professor Gu has also served on the editorial boards of 18 international journals. He was awarded the prestigious *Beattie Steel Medal* from the Australian Optical Society in 2011.

Key Areas of Research Contribution

Prof Gu's areas of focus are

- All optical super resolution technology development for the fabrication of two- and three-dimensional nanoplasmonic and functional metamaterials.
- Chiral lattices as optical structures for polarisation control and circular dichroism.
- Metallisation of linear polymers and non-linear chalcogenide materials for nanoplasmonics.
- Non-Airy, diffraction limited focal arrays for parallel processing.

2011 Achievements

Chalcogenide Nanowires

In a paper published in Nano Letters [1], Professor Min Gu and researchers from Swinburne University of Technology and the Australian National University demonstrated the fabrication of nanowire less than seventy nanometres in diameter using chalcogenide glass, a nonlinear optical material. These nanowires mark a significant step towards the realisation of the CUDOS all optical photonic chip. This research was reported in The Age [2], Cosmos magazine [3] and on ABC radio Australia.

Reversal of the Doppler Effect at optical wavelengths

In collaboration with the University of Shanghai, Min Gu and his team demonstrated the reversal of the Doppler Effect at optical wavelengths. Published in Nature Photonics [4] the paper demonstrated a phenomena that does not occur in the natural world: when an object and a light wave detector moved closer together, the light frequency decreases from blue wavelengths to red ones, and vice versa. This was achieved by creating an artificial nanostructured crystal out of silicon with the

negative refractive index required to achieve this result. The research has advanced their understanding of optics and could one day lead to the development of practical invisibility cloak technology.

Nonlinear metamaterials

In collaboration with PI Zheludev, Professor Gu and his research team harnessed the nanoscale confinement of light and the nonlinearity of metal to achieve resonant switching in a nanostructured gold film. The performance is at least one order of magnitude faster and stronger than other materials. It exceeds electronic component speeds by a factor of a thousand and achieves control of light with light in a film only 50 nm thick at an average light power level of only a few milliwatts, thus providing a ground-breaking solution for all-optical data processing, including ultrafast optical limiters, saturable absorbers, and terahertz bandwidth all-optical gates.

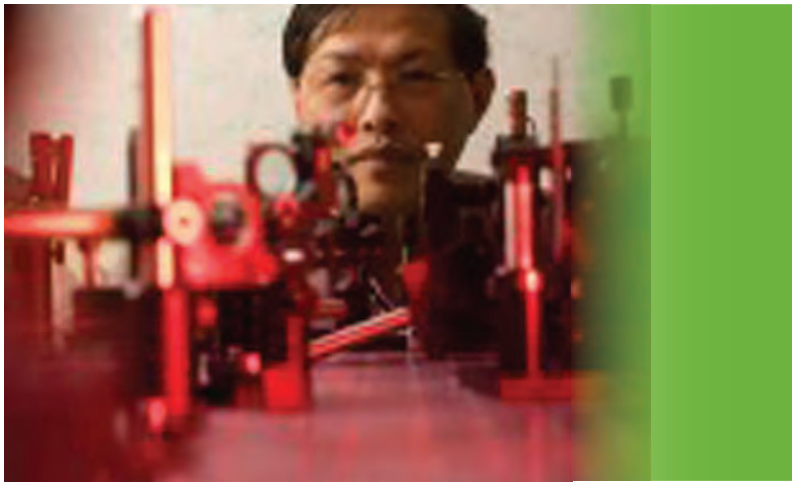
Development of SPIN allows for λ/24 resolution

Super-resolution photoinduction-inhibited nanofabrication (SPIN) developed at Swinburne in collaboration with CSIRO is an all optical technique allowing for the rapid fabrication of sub-diffraction limited nanostructures [5]. This multiphoton technique was used to demonstrate the world's smallest structures using all optical technology for dot and lines down to 50 nm or λ/24, significantly better than the resolution reported by other groups. The research group will now apply this world breaking research to the fabrication of complex two- and three-dimensional nanoplasmonic and functional metamaterial devices.

Recognition

In 2011 Professor Min Gu was awarded the WH (Beattie) Steel Medal from the Australian Optical Society. Considered Australia's most prestigious award in optics, the medal recognises Professor Gu's strong and sustained record of authority, enterprise and innovation in the field of optics.

Professor Gu and the VSASF research team received the 2011 Vice-Chancellor's Industry Engagement Award from Swinburne University of Technology, Australia. The award was in recognition of providing cutting-edge technological services to industry and gaining industry endorsement of Swinburne's research excellence; developing industry-engaged learning and a training partnership with Suntech for both undergraduate and research students; and promoting Swinburne's profile in industry engagement and boosting the University's reputation nationally and internationally.



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4. J. Chen, Y. Wang, B. Jia, T. Geng, X. Li, L. Feng, W. Qian, B. Liang, X. Zhang, M. Gu, and S. Zhuang, "Observation of the inverse Doppler effect in negative-index materials at optical frequencies," Nat Photon **5**, 239-245 (2011).
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