

International Conference on the Physics of Semiconductors (ICPS 2026), Tokyo, Japan: Conference Report

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Introduction

The 37th International Conference on the Physics of Semiconductors (ICPS 2026) was held from 16-21 August at the Keio Plaza Hotel in Shinjuku, Tokyo. ICPS is one of the most prestigious and longest standing international conferences on semiconductor physics, first established in the 1950s. The conference brings together leading researchers from around the world working across electronic, material, optical, magnetic and quantum properties of semiconductor materials.

I was extremely fortunate to receive financial support from UKNC which enabled me to travel to Japan to attend and present at the conference. This was an incredible opportunity for me in the final stages of my PhD, both to present my work to an international audience and to hear directly from many of the leading researchers in developing semiconductor physics and quantum technologies.

The significance of the meeting was apparent from the opening ceremony, which was attended by Her Imperial Highness Princess Aiko of Japan, who delivered an opening address, alongside the Prime Minister of Japan, the Minister of Science and other heads of governing and scientific bodies. In her remarks, Princess Aiko highlighted the importance of scientific discussion that exceeds national borders to drive technological progress. She emphasised the fundamental role of semiconductor research in modern society and its importance for AI, communications, energy and a sustainable future. She also discussed the value of international scientific collaboration and expressed her hope that ICPS would be a valuable experience for the next generation of researchers.

The scientific programme was exceptionally broad, with seven parallel oral sessions throughout, alongside plenary lectures and extensive poster sessions. I presented a talk titled "Deterministic depth-controlled growth of room-temperature quantum emitters in GaN" in the "Emerging Solid-State Quantum Emitters and Photonic Devices" session,

which was a collaboration between ourselves at Cardiff University and the Cambridge Centre for Gallium Nitride. The sessions on wide-bandgap semiconductors, quantum optics, quantum emitters, nanophotonics and semiconductor quantum technologies were of particular relevance to my research. I have highlighted below the presentations that I found most interesting to both myself and the wider UK nitrides community.

Hiroshi Amano, *Nitride Semiconductors: General Lighting and Beyond*

One of the highlights of the conference was a special plenary talk by Professor Hiroshi Amano of Nagoya University and Nobel Laureate of Physics for his work on developing efficient blue LEDs. His presentation provided a perspective on the development of the nitride semiconductor field and progression from materials research towards technologies that have had substantial global impact.

The talk followed the development of GaN from a material that was very challenging to grow to its use across modern lighting. Professor Amano discussed the importance of the work that resulted in improved GaN crystalline growth, p-type doping and InGaN active regions in enabling efficient GaN LEDs that we all use today.

What I found most interesting was the discussion on what comes beyond lighting. Amano emphasised that GaN is also important for power electronics, where its wide bandgap and high breakdown field provide advantages over standard silicon devices. For me, this was also an interesting reminder of how the applications of GaN have continued to evolve. It was particularly special to hear this perspective directly from one of the researchers responsible for some of the foundational advances in the field.

Umesh Mishra, *Gallium Nitride: A Story of Taking Differentiated Physics into the Marketplace*

A second plenary was given by Professor Umesh Mishra from the University of California, Santa Barbara. His presentation considered the development of GaN technologies from the perspective of translating the unusual physical properties of the material into practical devices.

The presentation demonstrated how fundamental properties of the III-nitrides have been exploited. This has enabled GaN to establish itself across optoelectronic, RF and power-electronic technologies. I found the presentation particularly useful because it placed the more fundamental research presented elsewhere at ICPS into a wider context. The history of nitride research demonstrates that understanding unusual or initially problematic physical properties can ultimately lead to entirely new device technologies.

Gabriele Grosso, *Hybrid Quantum Defect Complexes in Wide-Bandgap Nitride Materials*

The invited presentation by Professor Gabriele Grosso from the City University of New York was among the talks most directly relevant to my PhD research. His presentation focused on quantum defect complexes in nitride materials.

A central challenge for defect-based quantum emitters is determining the microscopic or atomic structure responsible for the variation in observed optical emission. This is particularly difficult in III-V materials such as GaN, aluminium nitride (AlN) and hexagonal boron nitride (hBN), where quantum emitters occur across a very broad range of wavelengths.

His work considers non-local recombination between spatially separated defect states through a donor-acceptor-pair-like mechanism. The photon energy therefore depends on both the electronic states and the separation between the interacting defects. Time-resolved spectroscopy showed discrete switching between emission lines, which could be reproduced using sequences associated with harmonic nitrogen π^* states identified by resonant inelastic X-ray scattering (RIXS). The presentation highlighted how RIXS can be combined with theoretical calculations to investigate the microscopic origin of quantum emission. Prof. Grosso argued that this can also be extended to emitters in AlN and GaN, which I found very interesting.

Jörg Wrachtrup, *Characterizing a 25 Qubit Spin Quantum Register in SiC*

Professor Jörg Wrachtrup from the University of Stuttgart presented work on optically active defects in silicon carbide, another wide-bandgap semiconductor increasingly investigated for quantum technologies. His invited talk focused on the characterisation of a 25-qubit spin register in SiC.

The work used silicon vacancy defect states as optically addressable spin systems. Photoluminescence excitation measurements revealed narrow optical transitions associated with different spin states, while electrical structures were used to investigate and control the local environment of the defects.

One aspect that was especially interesting and relevant to me was the discussion of the influence of local electric fields on the optical transition. Applying a voltage through a Schottky-diode structure altered the properties of the photoluminescence excitation lines, demonstrating electrical control over the defect environment.

The SiC platform also demonstrated the importance of moving beyond characterisation of an isolated emitter. Integration with photonic structures, including reflectors and waveguides, was used to improve photon collection and coupling.

Debdeep Jena, *Quantum Computation and Communication Devices Using Nitride Semiconductors and Superconductors*

Professor Debdeep Jena from Cornell University presented an invited talk specifically considering the role that nitride semiconductors and superconductors could play in quantum computation and communication. I found this presentation particularly valuable because it connected the established properties of III-nitride materials with emerging quantum technologies.

He discussed progress with using NbN/AlN/NbN stacks to process into Josephson junctions as components in quantum devices for qubit generation, with future plans to integrate these with resonators for use in scalable quantum technologies.

Women in Physics Session

I also attended the Women in Physics session, which provided an opportunity to consider some of the wider challenges surrounding representation and career progression in physics.

Professor Gloria Platero discussed the continued underrepresentation of women throughout physics. She highlighted the importance of visible female role models and representation in teaching materials, invited talks, awards and decision-making positions.

Professor Juniko Ishi-Hayase provided a perspective from Japan, where women remain particularly underrepresented in STEM degrees and senior academic positions despite strong academic performance among girls at school. I found the discussion around the transition from school to university, confidence, career uncertainty and the perceived risks associated with pursuing a PhD particularly thought-provoking.

It was encouraging to see these issues given dedicated time within such a prestigious scientific conference, with discussion of practical ways in which the physics community can improve the participation and retention of women and girls in science. As you can see from the above talks - this still needs some work!

Acknowledgements

Attending ICPS 2026 was an exceptional opportunity and one of the highlights of my PhD. The prestige and scale of the conference meant that I was able to hear directly from internationally leading researchers across semiconductor physics, including Nobel Laureates and many of the researchers responsible for major developments in nitride semiconductors and semiconductor quantum technologies. The special plenary programme alone brought together Nobel Laureates Klaus von Klitzing and Hiroshi Amano, while the wider plenary programme included internationally recognised leaders across GaN and semiconductor quantum physics.

Being in Tokyo for a conference of this standing and attending an opening ceremony addressed by Her Imperial Highness Princess Aiko, made the experience particularly memorable. More importantly, the scientific programme gave me an opportunity to place my research on GaN quantum emitters within the rapidly developing field of solid-state quantum technologies.

I am extremely grateful to UKNC for providing the financial support that allowed me to attend. The opportunity to present my research, discuss it with researchers from across the international community and learn directly from world-leading scientists was invaluable. I returned from ICPS with new ideas for my research, a much broader understanding of the potential role of GaN quantum emitters in future quantum technologies and increased enthusiasm for continuing to work within the nitride semiconductor community.