Spontaneous Polarisation Build up in a Room Temperature Polariton Laser

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Semiconductor microcavities (MCs) offer a unique system for producing novel types of low threshold laser. This arises from the strong coupling between cavity photons and bound electron-hole pairs in the semiconductor emitters.[1] We previously predicted that such polariton lasers can operate without inversion, reducing emission thresholds considerably.[2-3] Here such systems are fabricated from lattice-matched monolithic GaN-based multilayers, including both bulk GaN and QW microcavities, which operate at room temperature. Coherent emission with a threshold below 0.1mW is demonstrated, which is nearly two orders of magnitude than the best previous GaN lasers.[4,5] These devices offer a new route to robust long-lived GaN lasers.

We demonstrate here that polaritons are thermalised to T~360K on sub-picosecond timescales below threshold, suggesting that they are indeed able to Bose condense at room temperature. However the most peculiar and novel feature of these emitters is that the coherent emission from this polariton condensate differs strongly in its polarisation properties from any previous laser. Each time the coherence is initiated using high-energy optical excitation, the polariton condensate chooses a different elliptical polarisation. The average spontaneous vector polarisation is ~50%. This spontaneous symmetry breaking is a signature for BEC, and by measuring single-shot polarisation dynamics we provide convincing additional evidence for BEC in these GaN microcavities.[6]

References

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