Title: Narrow linewidth visible/UV semiconductor disk lasers for quantum technologies.

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100-word text summary

We present GaInP single frequency semiconductor disk lasers designed for emission in the visible range. Two different structures optimized for emission at 675 and 689 nm have been designed. Stabilisation of the frequency relatively to a reference cavity allows for very low noise levels, down to 5 kHz over a 1 s time scale in both cases. We show that these sources are suitable for laser cooling of Strontium atoms, and that we can transfer the high coherence to UV wavelengths.

250-word text abstract

Optically-pumped semiconductor disk lasers (SDLs) have been shown over the past decade to possess all the qualities required for quantum technology applications. Indeed the very specific dynamics of these lasers make them perfect candidates to achieve low intensity noise and sub-Hz linewidth. Moreover, bandgap engineering and nonlinear conversion allow very broad spectral coverage from the ultraviolet to the mid-infrared, while the external cavity provides an excellent beam quality.

At the University of Strathclyde, we have been working for several years on GaInP based SDLs emitting in the 670-690 nm spectral band. Powers up to 1 W and single frequency emission have been achieved with these structures. By locking to a reference cavity, a relative frequency noise of 5 kHz (over 1 s) has been achieved, demonstrating the suitability of these sources for high coherence emission. This high coherence can be transferred to wavelengths in the UV by means of non-linear conversion. Such high coherence UV sources could find applications in UV photolithography or atmospheric spectroscopy.

We recently started to develop laser sources suitable for quantum technologies, in particular the laser cooling of Strontium atoms within optical clocks. A power above 100 mW and relative frequency stability of 5 kHz has been achieved. This narrow linewidth laser at 689 nm has been moved to the University of Birmingham and used to trap millions of Sr atoms cooling down to ~170µK. This establishes the narrow linewidth and high spectral purity of the laser. Results and characterisation carried out will be provided.