**Robust Measurement of Nanowire Laser Performance Across 8 Designs using Experimental Big-Data**

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Nanoscale coherent light sources are sought after as biological probes[1] and as active components for photonic integrated circuits[2]. Semiconductor Nanowires lasers (NWs) are well suited to this integration[3]; and provide diverse emission properties, arising from the wide choice of materials, whilst being united in their fundamental operating principle of the nanowire forming a monolithic cavity and gain material. However, this leads to a deterministic relationship between cavity, material and performance that results in no two NWs performing the same way[4]. This makes it difficult to scale-these devices up for applications that require high-yield and has made a reliable comparison study between different types of NWs a particular challenge.

We address these difficulties using automated optical microscopy to study 8 different NWL designs with 9 independent experiments[5], to measure the dimensions, bandgaps, carrier recombination lifetimes, lasing thresholds, wavelengths and coherence lengths of >50,000 NWs in total [Figure 1a-d]. This facilitates a statistically rigorous comparison of the performance of each type of NW [Figure 1e].

We use this approach to determine the best-in-class NWs and demonstrate that the behaviour of these champion devices is not representative of the NW population. This traditional approach for inter-class comparison is therefore ambiguous. Additionally, by combining the datasets for all types of NWs, we confirm the long-standing prediction that the length and reflectivity of the NW cavity are the most important factors controlling the lasing threshold for any type of NW[6]. This therefore elucidates a route towards achieving homogeneous performance across a population of all NWs.

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