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Lasing Reporting Summary

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Experimental design

Please check: are the following details reported in the manuscript?

1. Threshold

Plots of device output power versus pump power over a wide range of values indicating a clear threshold	☒ Yes ☐ No	Figure 1,3 in the manuscript

2. Linewidth narrowing

Plots of spectral power density for the emission at pump powers below, around, and above the lasing threshold, indicating a clear linewidth narrowing at threshold	☒ Yes ☐ No	Figure 1,3 in the manuscript
Resolution of the spectrometer used to make spectral measurements	☒ Yes ☐ No	Figure 1,3 in the manuscript

3. Coherent emission

Measurements of the coherence and/or polarization of the emission	☒ Yes ☐ No	Figure 2,4 and 5 in the manuscript

4. Beam spatial profile

Image and/or measurement of the spatial shape and profile of the emission, showing a well-defined beam above threshold	☒ Yes ☐ No	Figure 2,3 and 5 in the manuscript

5. Operating conditions

Description of the laser and pumping conditions *Continuous-wave, pulsed, temperature of operation*	☒ Yes ☐ No	Femtosecond pulsed laser
Threshold values provided as density values (e.g. W cm^{-2} or J cm^{-2}) taking into account the area of the device	☒ Yes ☐ No	21 μJ/cm2

6. Alternative explanations

Reasoning as to why alternative explanations have been ruled out as responsible for the emission characteristics *e.g. amplified spontaneous, directional scattering; modification of fluorescence spectrum by the cavity*	☒ Yes ☐ No	Para 1,3 in Page 6 in the manuscript, Para 1,2 in Page 10 in the manuscript

7. Theoretical analysis

Theoretical analysis that ensures that the experimental values measured are realistic and reasonable *e.g. laser threshold, linewidth, cavity gain-loss, efficiency*	☒ Yes ☐ No	Section1, 3 in Supplementary information

8. Statistics

Number of devices fabricated and tested	☒ Yes ☐ No	More than ten sets of samples
Statistical analysis of the device performance and lifetime (time to failure)	☒ Yes ☐ No	Able to keep the laser stable after 3600000 pulses,and the sample can maintain good laser performance for nearly two weeks after packaging