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GaAs ナノワイヤを用いた近赤外域プラズモンレーザの実現

Demonstration of plasmonic laser in near infrared region using a GaAs nanowire

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The nanolaser is a key component for the on-chip integration of nanophotonics and electronics. Semiconductor nanowires (NWs) are ideal for the miniaturization of lasers. When placed adjacent to metallic structures, NWs can support surface plasmon polariton (SPP) modes, allowing lasing at subwavelength dimensions. Visible NW plasmonic lasers lasing from 490 nm to 522 nm based on CdS and GaN respectively have been demonstrated [1,2], but GaAs NWs lasing in the technologically important infrared region has thus far been limited to dielectric optical cavities which are diffraction limited. Here, we demonstrate plasmonic lasing using MOCVD grown GaAs/AlGaAs core-shell nanowires placed on a thin silver film. Compared to previous optical GaAs NW lasers with diameters larger than 340 nm, our NWs have diameters of 150 nm. To our knowledge, this is the first demonstration of a plasmonic laser in the near-infrared region.

We verified the plasmonic nature of our NW lasers by performing micro-photoluminescence on NWs dispersed on both silver and silicon. The samples were excited with a pulsed laser with λ = 785 nm at 8 K. While NWs dispersed on silicon exhibit broad emission from the bulk GaAs, NWs dispersed on silver exhibit Fabry-Perot mode peaks [3] which provide optical feedback required for lasing. We observed lasing behavior from NWs with well cleaved facets, with a threshold of 70 μW. Based on rate equation fitting, we obtain a high spontaneous emission coupling β-factor greater than 0.18.

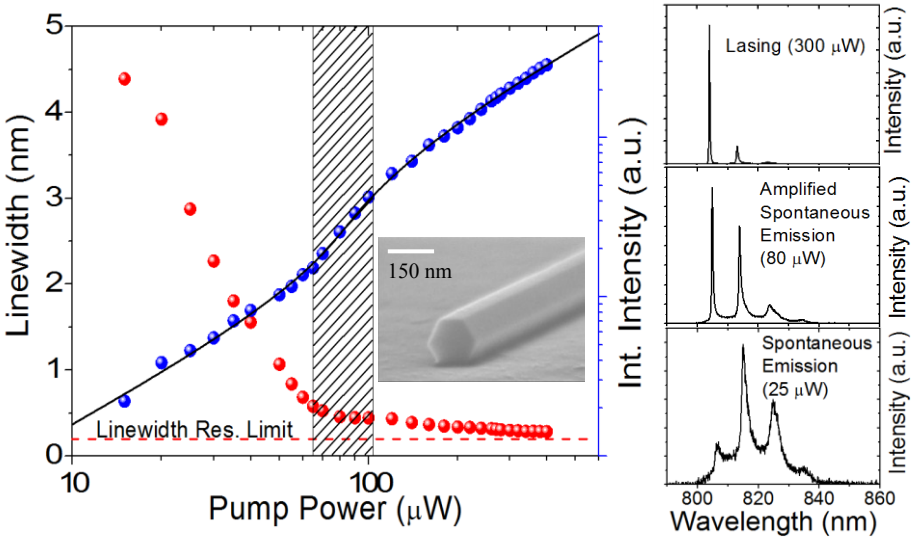

Figure 1. *L-L* plot of lasing peak at 804 nm, with threshold of 70 μW and high β-factor of > 0.18. Inset shows SEM image of NW on silver, and spectra for spontaneous emission, amplified spontaneous emission and lasing are shown on the right.

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References

[1] R. F. Oulton *et al., Nature* **461**, 629 – 632 (2009). [2] Y. –J. Lu *et al., Science* **337**, 450-453 (2012). [3] J. F. Ho *et al., 61st JSAP Spring Meeting* 17a-PA1-5 (2014).