

DNA-assembled Plasmonic Waveguides for Nanoscale Light Propagation to a Fluorescent Nanodiamond

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Plasmonic waveguides consisting of metal nanoparticle chains can localize and guide light well below the diffraction limit, but high propagation losses due to lithography-limited large interparticle spacing have impeded practical applications. We previously demonstrated a robust DNA-origami-based self-assembly pipeline of monocrystalline gold nanoparticles.¹ More recently,² we demonstrate that this method allows the interparticle spacing to be decreased below 2 nm, thus reducing propagation losses to 0.8 dB per 50 nm at a deep subwavelength confinement of 62 nm ($\sim\lambda/10$). We characterize the individual waveguides with nanometer-scale resolution by electron energy-loss spectroscopy. Light propagation towards a fluorescent nanodiamond is directly visualized by cathodoluminescence imaging spectroscopy on a single-device level, therefore realizing nanoscale light manipulation and energy conversion. Simulations suggest that longitudinal plasmon modes arising from the narrow gaps are responsible for the efficient waveguiding. With this scalable DNA origami approach, micrometer-long propagation lengths could be achieved, enabling applications in information technology, sensing and quantum optics.²

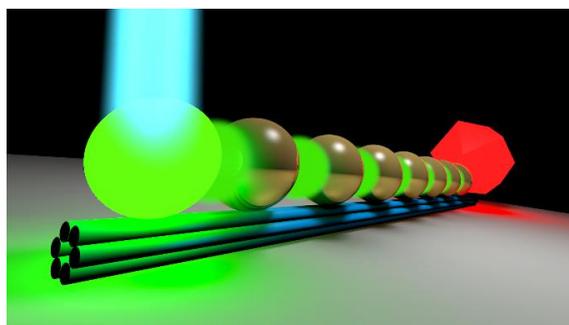


Figure 1: Artistic representation of energy transfer to a fluorescent nanodiamond.

Reference

- [1] Gür, F. N.; Schwarz, F. W.; Ye, J.; Diez, S.; Schmidt, T. L. Toward Self-Assembled Plasmonic Devices: High-Yield Arrangement of Gold Nanoparticles on DNA Origami Templates. *ACS Nano* **2016**, *10* (5), 5374–5382.
- [2] Gür, F. N.; McPolin, C. P. T.; Raza, S.; Mayer, M.; Roth, D. J.; Steiner, A. M.; Löffler, M.; Fery, A.; Brongersma, M. L.; Zayats, A. V.; et al. DNA-Assembled Plasmonic Waveguides for Nanoscale Light Propagation to a Fluorescent Nanodiamond. *Nano Lett.* **2018** *18* (11), 7323-7329.