“Writing” Single-Photon Sources for Room-Temperature On-Chip Operation

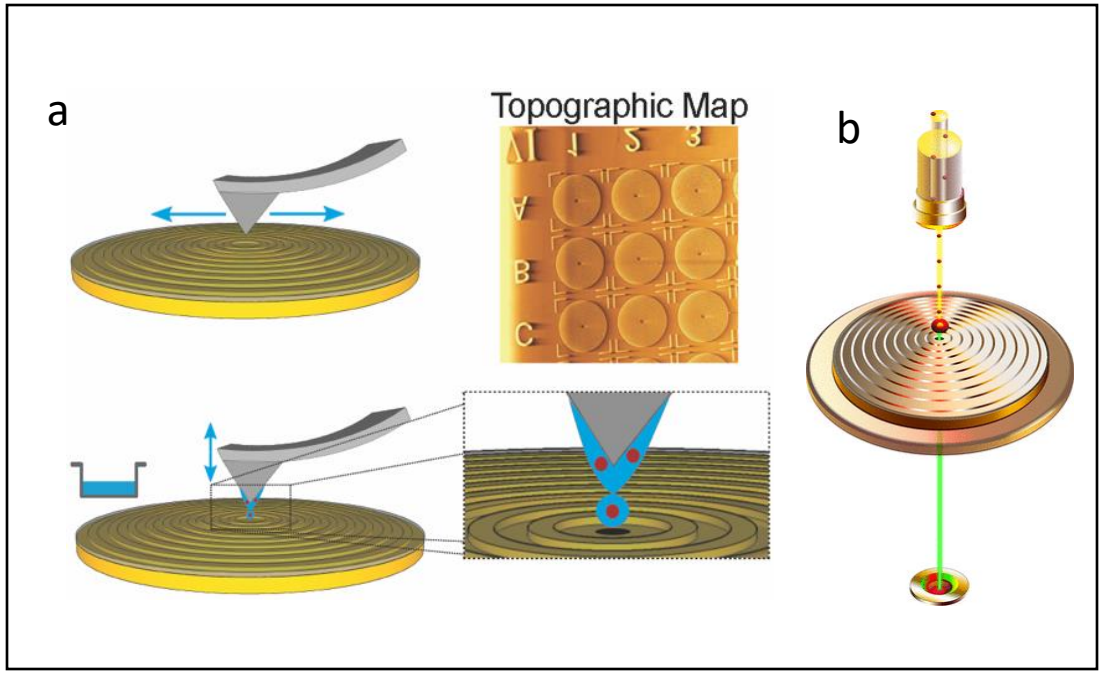

Figure: Direct-write dip-pen nanolithography (DPN) maps and places individual quantum dots into the holes of hybrid metal-dielectric bullseye antennas. (b) Antenna design permits back excitation and front photon collection directly into an optical fiber.

Scientific Achievement

Novel “direct-write” integration of solution-processed single-photon emitter and photonic antenna that combines back-excitation with forward directionality collection.

Significance and Impact

Enables coupling of emitted photons into an optical fiber without any coupling optics toward compact, networked secure and highly efficient quantum communication systems integrated on-chip.

Research Details

- Nanocrystal emitters positioned inside light-directing antennas.
- Demonstrated front collection efficiencies of ~70% at NAs as low as 0.5.

Work was performed, in part, at the Center for Integrated Nanotechnologies.

Lubotzky, B.; Nazarov, A.; Abudayyeh, H.; Antoniuk, L.; Lettner, N.; Agafonov, V.; Bennett, A. V.; Majumder, S.; Chandrasekaran, V.; Bowes, E. G.; Htoon, H.; Hollingsworth, J. A.; Kubanek, A.; Rapaport, R. Room-Temperature Fiber-Coupled Single-Photon Sources Based on Colloidal Quantum Dots and SIV Centers in Back-Excited Nanoantennas. *Nano Letters.* 2024.