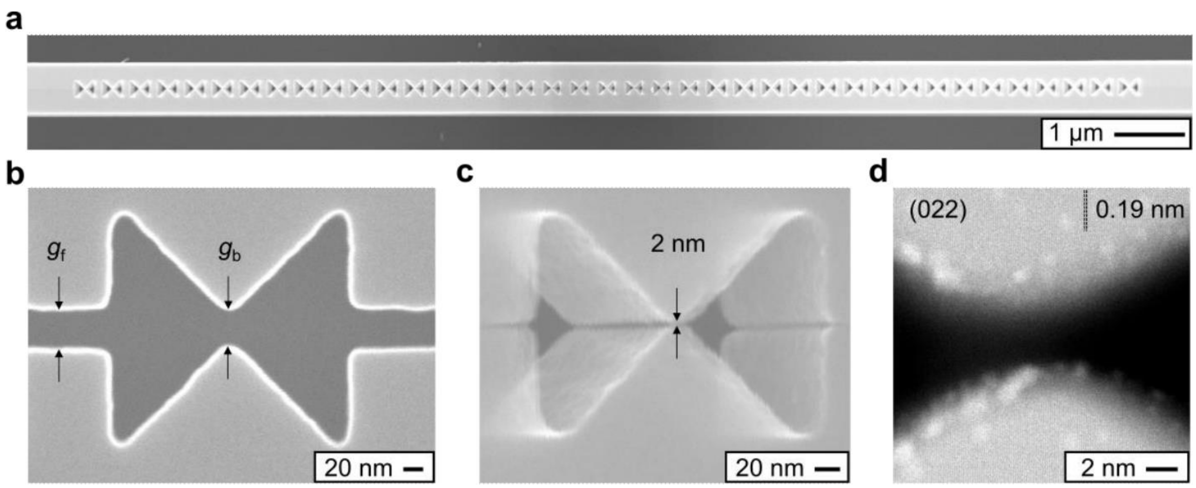
## ANNUAL HIGHLIGHTS

NanoPhoton is devoted to the physics and applications of a new generation of optical cavities with deep sub-wavelength confinement of light, known as Extreme Dielectric Confinement (EDC). These cavities have features so small that they cannot be fabricated with standard fabrication techniques, and part of the research is therefore concerned with developing and testing new nanofabrication techniques. In particular, we have spent considerable time and resources investigating the use of self-assembly by nanoscale surface forces to make features so small that they can likely never be fabricated by conventional methods; see figure below. As a significant scientific result of 2023, the fruits of this work were published in Nature [1] and received considerable attention from technology news outlets and colleagues worldwide.

When operated as lasers, the EDC cavities provide new and exciting possibilities for tailoring the properties of the emitted laser light, and part of the theoretical work in the centre is concerned with modelling and predicting the performance of such nanolasers. Therefore, we were delighted to find a surprisingly accurate way of modelling the quantum intensity noise in such lasers using a stochastic formulation of the standard laser rate equations. This result, published in Physical Review Letters [2], substantially simplifies the description of nanolasers and provides new physical insights to the nature of the laser light generation.

Optical cavities can dramatically increase the rate of spontaneous emission of single photons from quantum emitters, and this effect is known to scale inversely with the degree of spatial light confinement. In a line of scientific results in this area, we have successfully demonstrated high-purity single photon sources utilizing a single QD coupled to a photonic cavity, achieving an impressive fabrication yield exceeding 30% [3]. The emission wavelength is in the technologically interesting telecom C-band, and by implementing a resonant excitation scheme, we have achieved record-high photon indistinguishability for this wavelength range.

In the fourth year of NanoPhoton, we are happy and proud that 18 centre members gave invited talks at international conferences and workshops around the world. On the personnel side, NanoPhoton members Søren Stobbe (WP1 leader) and Martijn Wubs became full professors. Finally, we note that NanoPhoton members were able to attract funding to several projects that have strong synergy with NanoPhoton.




*Self-assembled optical cavity (a) and method of fabrication. In the initial step (b), the features defining the two halves of the cavity are fabricated with the resolution made possible by precise etching. In the subsequent step, the two halves collapse to create the final slit of only 2 nm (c,d).*