Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary Information:

Chip-integrated plasmonic cavity-enhanced single nitrogen vacancy center emission

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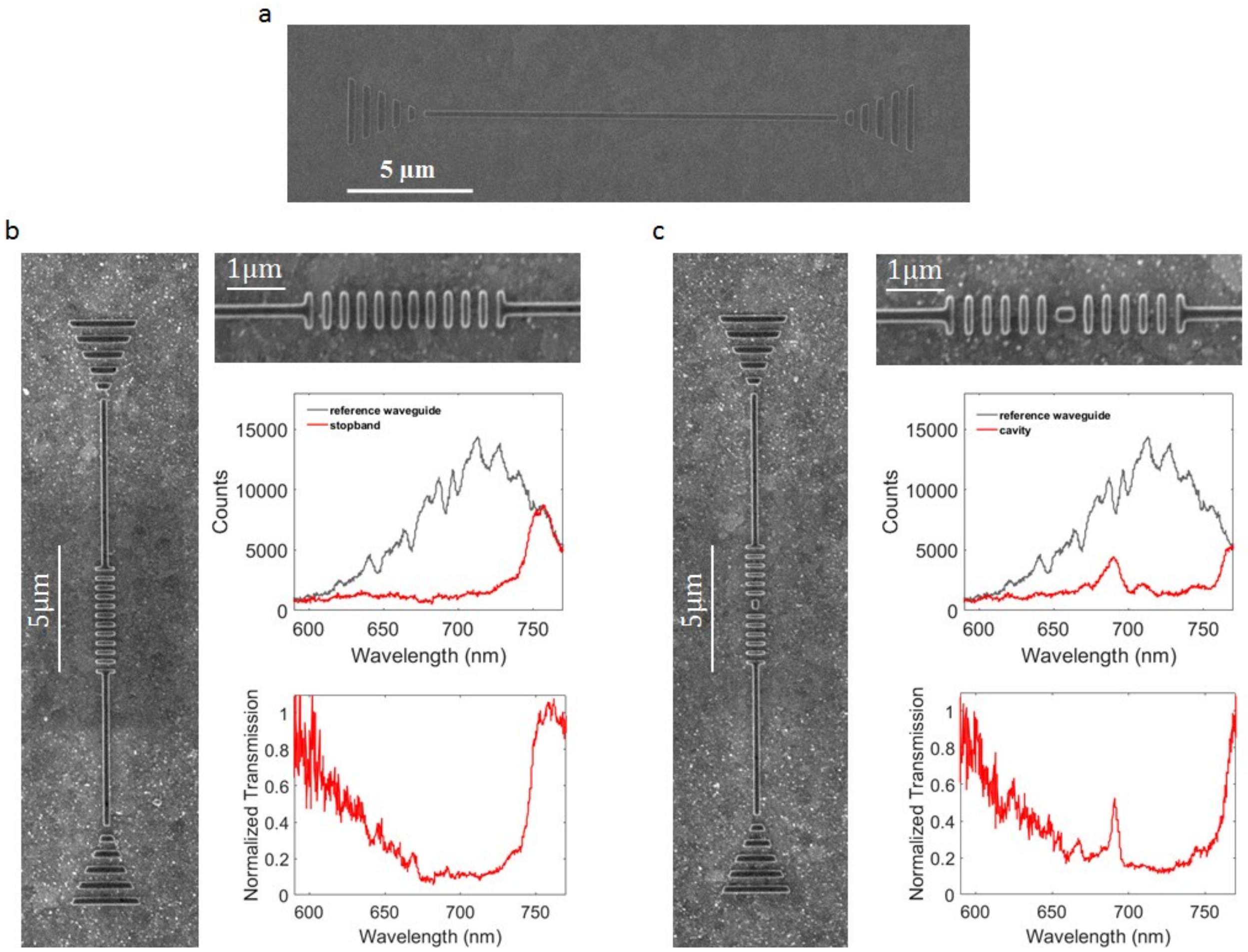
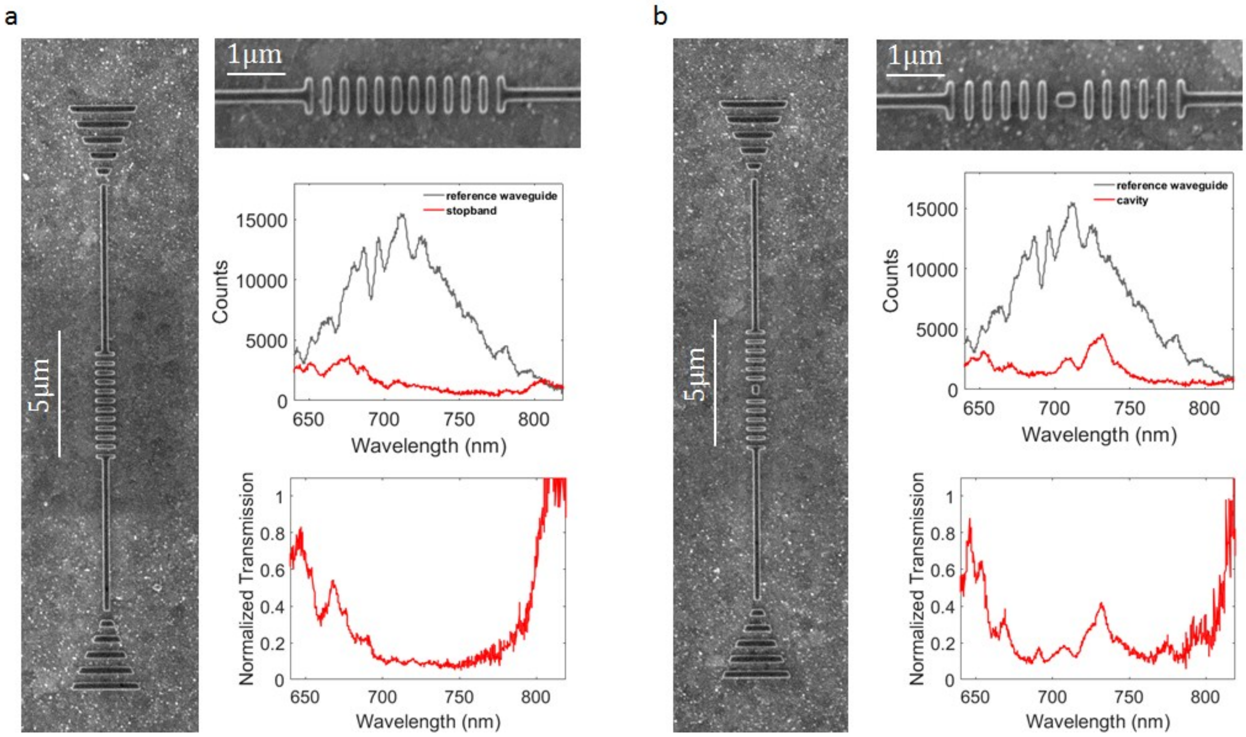
1. Optical characterization of DLSPP waveguide-integrated cavities

Far-field characterization of the DLSPP waveguide-integrated cavities for two different Bragg wavelengths of λ=680nm (NV¯ emission peak) and λ=738nm (SiV-center, ZPL) are illustrated in the supplementary figures S1 and S2, respectively. The transmission is measured using a super continuum source to excite one grating end, whereas the other one monitor the transmission of the guided SPP mode through the structure. The transmission data for each device is normalized to the average transmission through a set of DLSPP straight reference waveguides (Figure S1a) that are patterned on the same sample and measured under the same coupling conditions. The transmission through the straight waveguide (Fig S1b, top right) is influenced by the propagation loss and the grating coupler efficiency.

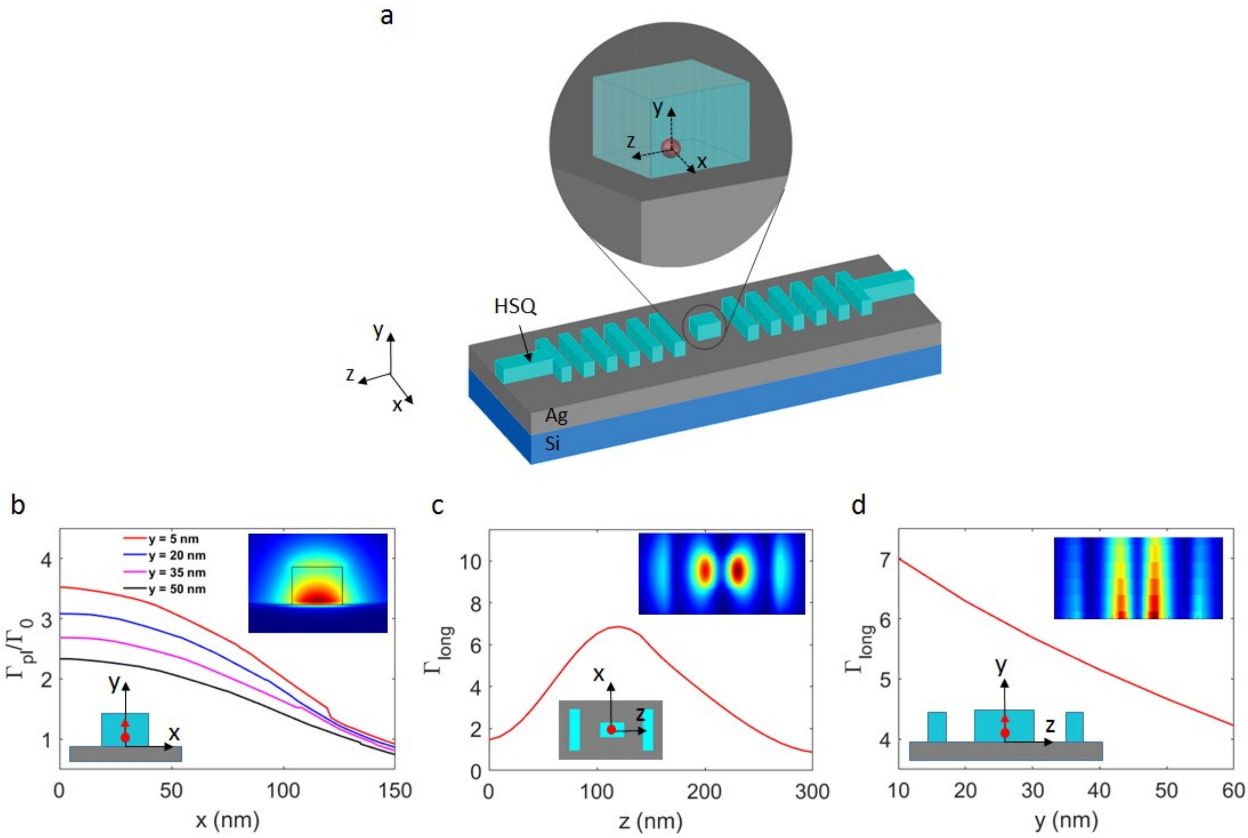


Figures **S1** Far-field characterization of DLSPP waveguide-integrated cavity. (a) Scanning electron micrograph (SEM) of a straight DLSPP waveguide (reference waveguide). (b) SEM image of a DLSPPW-based distributed Bragg reflector (left), transmission data for reference waveguide and DBR (top right), and normalized transmission of DBR (bottom left). (c) SEM image of a DLSPPW-based cavity (left), transmission data for reference waveguide and cavity (top right), and normalized transmission of cavity (bottom left). The quarter wave stack period of 300 nm is designed to have resonance at λ=680nm (NV¯ peak).



Figures **S2** Far-field characterization of DLSPP waveguide-integrated cavity. (a) SEM image of a DLSPPW-based distributed Bragg reflector (left), transmission data for reference waveguide and DBR (top right), and normalized transmission of DBR (bottom left). (b) SEM image of a DLSPPW-based cavity (left), transmission data for reference waveguide and cavity (top right), and normalized transmission of cavity (bottom left). The quarter wave stack period of 325 nm is designed to have resonance at λ=738nm (SiV-center, ZPL).

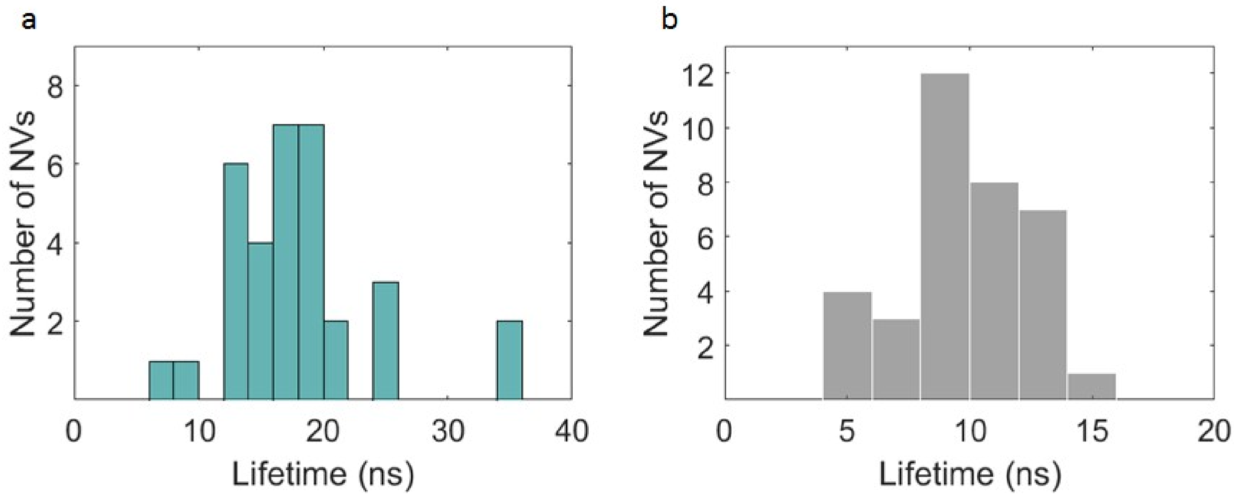
2. Influence of NV-center position



Figures **S3** Position dependence of the plasmonic decay rate for DLSPP cavity-coupled NV emitter with a vertically oriented dipole (y-polarized) (a) Schematic of hybrid system of NV emitter and cavity. (b) Simulated plasmonic decay rate enhancement of coupled NV due to the transverse confinement of DLSPP rectangle waveguide (Γ_{pl}/Γ_0) when emitter's position changed along x axis for different y positions. Inset shows the distribution profile of plasmonic decay rate for the DLSPPW coupled NV center in xy-plane. (c) Plasmonic decay rate enhancement coupled NV due to the longitudinal confinement of Bragg cavity (Γ_{long}) for when emitter's position changed along z axis (y=25 nm, x=0 nm). Inset shows the distribution profile of longitudinal plasmonic decay rate for the cavity coupled NV center in xz-plane. (d) Influence of NV position on longitudinal enhancement when emitter moved along y-axis. Inset shows the distribution profile of longitudinal plasmonic decay rate for the cavity coupled NV center in yz-plane.

3. Distribution of fluorescence lifetimes for single-photon NV emitters

We compare the histogram of lifetimes measured for NVs both on glass and on silver film. The result indicates an average lifetime reduction of ~2 for the silver film (from ~18.1 ns on glass to ~9.4 ns on silver film).



Figures **S4** Distribution of fluorescence lifetimes for single-photon NV emitters on glass (a) and on silver film (b) indicating an average Purcell factor of 2 for the silver film.