Supporting Information for

High-Directionality Spin-Selective Routing of Photons in Plasmonic Nanocircuits

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S1: FDTD simulation and optimization of the geometric parameters under normal and non-normal incidence

S1.1: Design optimization of geometry under normal illumination

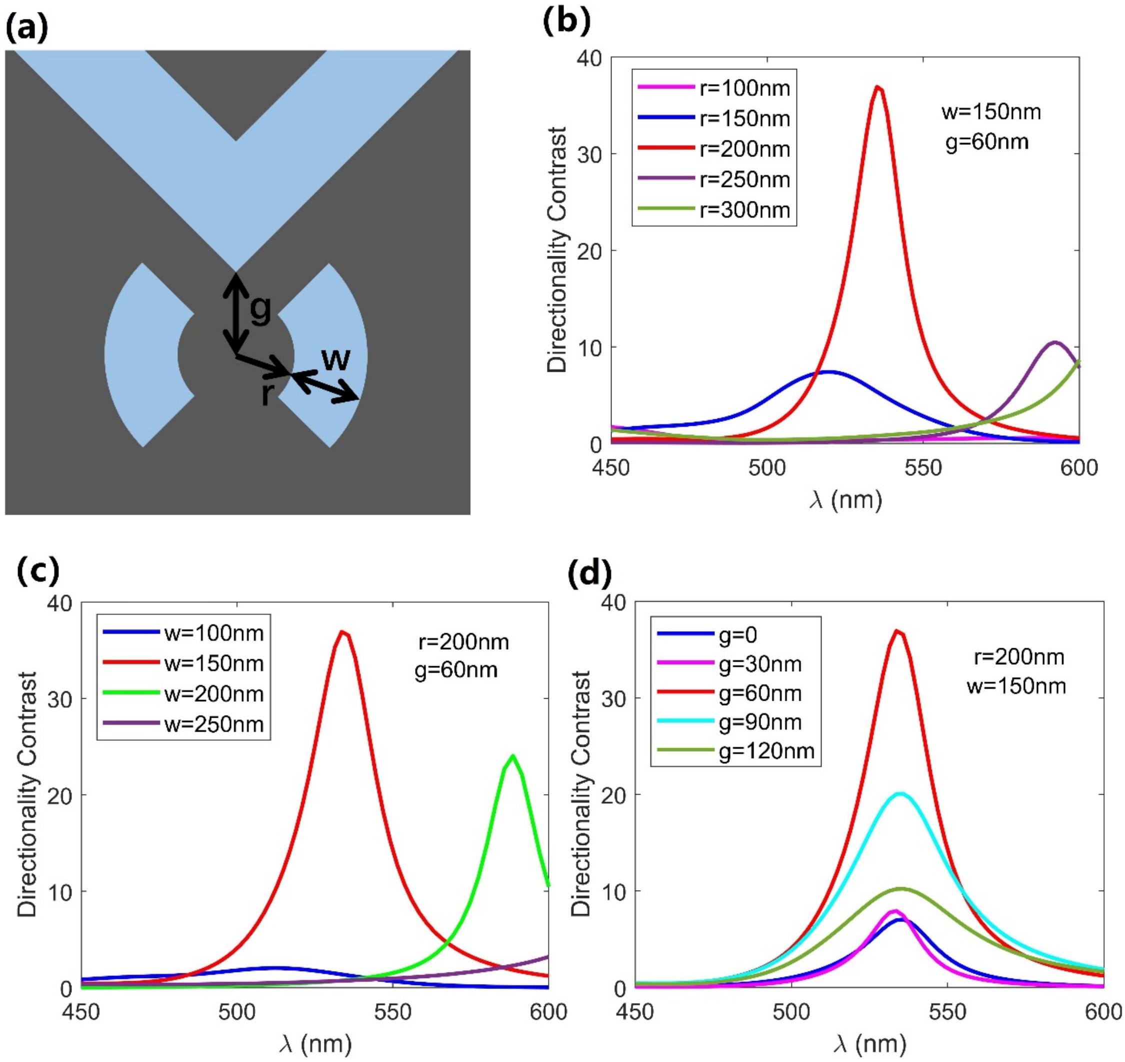

Figure S1.1. 3D-FDTD design optimization of the proposed device for larger directionality contrast between the two branching DLSPPs waveguide channels. The directionality contrast is defined as I_L / I_R under LCP illumination. (a) The top view of the SRC with inner radius of *r* and width of *w*. The distance between the center of SRC and the apex of two orthogonal DLSPPs waveguides is noted as *g*. (b) Directionality contrast as a function of excitation wavelength for different inner radius *r* while keeping the values of *w* and *g* constant as w = 150 nm and g = 60 nm, respectively. Due to the resonant characteristics of SRC, a strong peak is observed at λ = 532 nm for r = 200 nm with a maximum directionality contrast. (c) Directionality contrast as a function of wavelength for different ring width *w* while keeping r = 200 nm and g = 60 nm reveals the optimal value of w = 150 nm. (d) Directionality contrast as a function of wavelength for device with optimized parameters of r = 200 nm and w = 150 nm while varying the value of *g*. Due to the fact that the parameters of SRC are fixed, thus the location of resonant peak is almost unchanged.

S1.2: Optical response of device under non-normal illumination

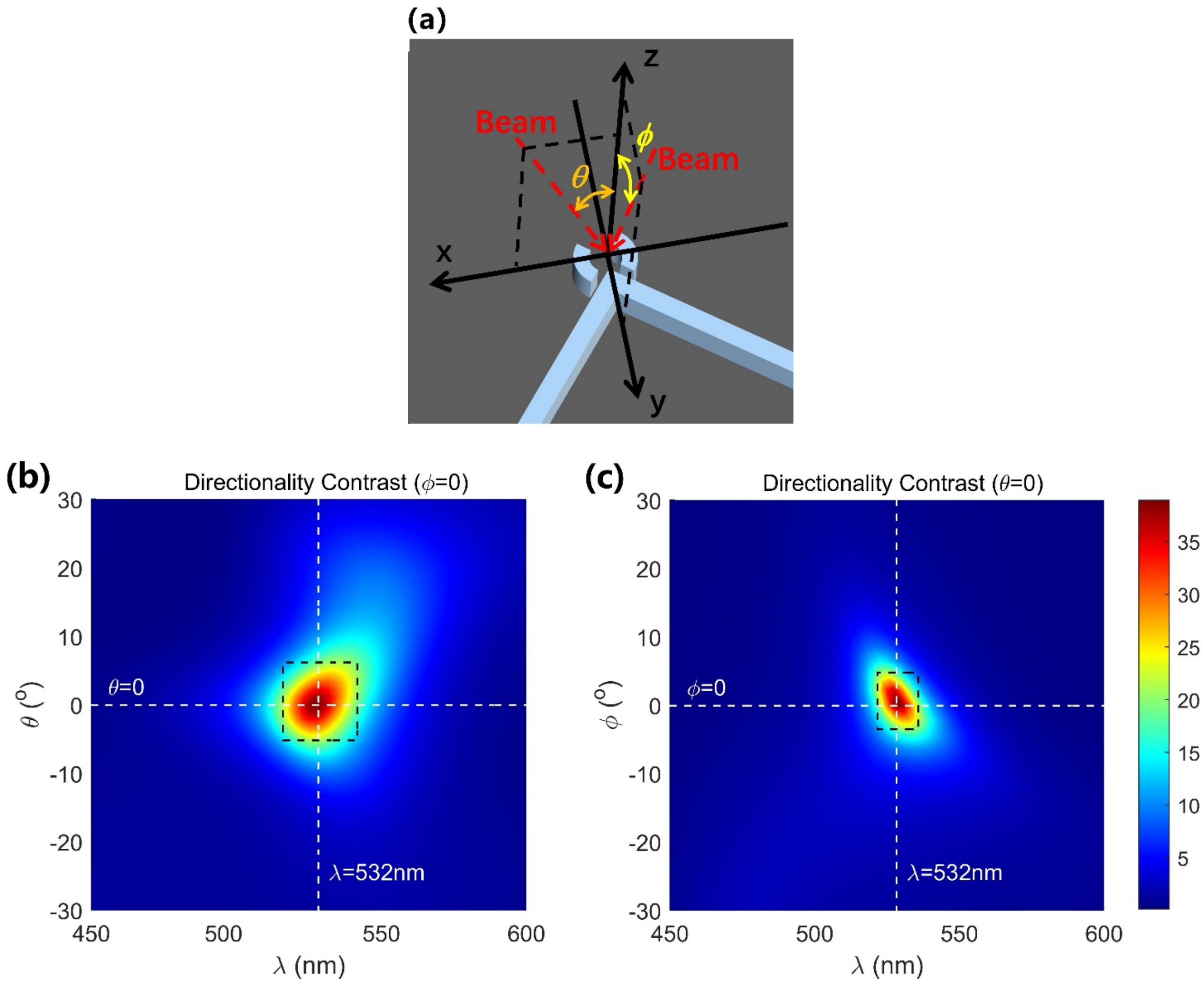

Figure S1.2. 3D-FDTD study of the directionality contrast as functions of both excitation wavelength and nor-normal incident angle. (a) Schematic diagram of the considered coordinate system with respect to the proposed device. We assumed that the beam obliquely shines the device in the x-z plane and y-z plane, with incident angles of θ and ϕ, respectively. (b) Directionality contrast as functions of excitation wavelength and angle θ with $\phi = 0$, which is clearly shown the resonant spectral characteristics for θ varying from -6^{o} to 6^{o}, as shown by the black dashed box. Two dashed white lines indicate the wavelength $\lambda = 532$ nm and incident angle $\theta = 0$. (c) The influence of excitation wavelength and angle ϕ on directionality contrast with $\theta = 0$. Same phenomenon is observed. The results demonstrate the proposed nanocircuit possesses a strong tolerance against the tilted incident angles within ± 5^{o} in x-z and y-z planes ensuring a high average directionality contrast over 25.

S2: Sample fabrication

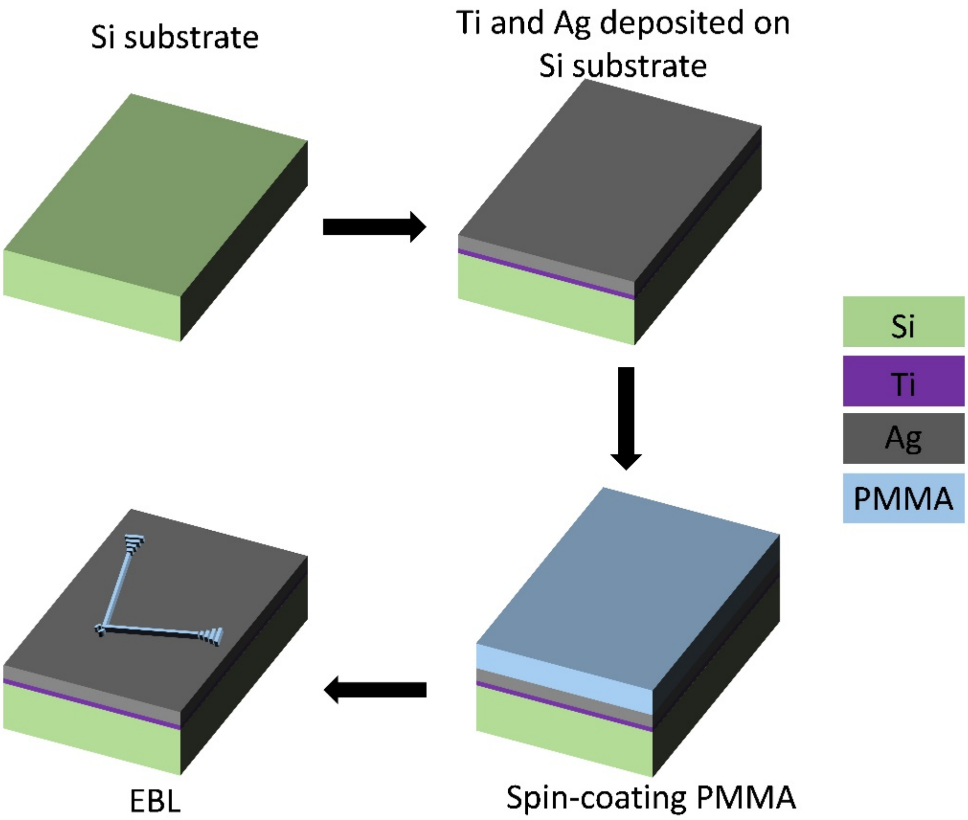

Figure S2.1. Fabrication process of the samples. The Ti and Ag films are successively deposited on the Si substrate. The structured Ag surface is then covered by a PMMA layer using spin-coating, and then the samples are prepared utilizing EBL.

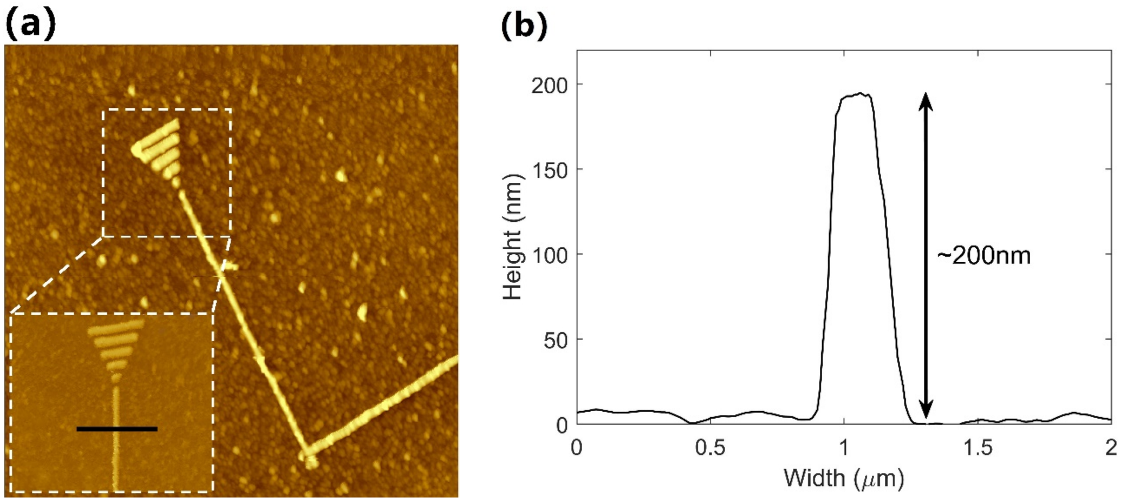

Figure S2.2. (a) The atomic force microscopy (AFM) image of the fabricated sample. (b) The height profile across the blackline depicted in the inset of (a), validating the fabrication precision.

S3: Optical setup utilized for characterization of DLSPPs directionality

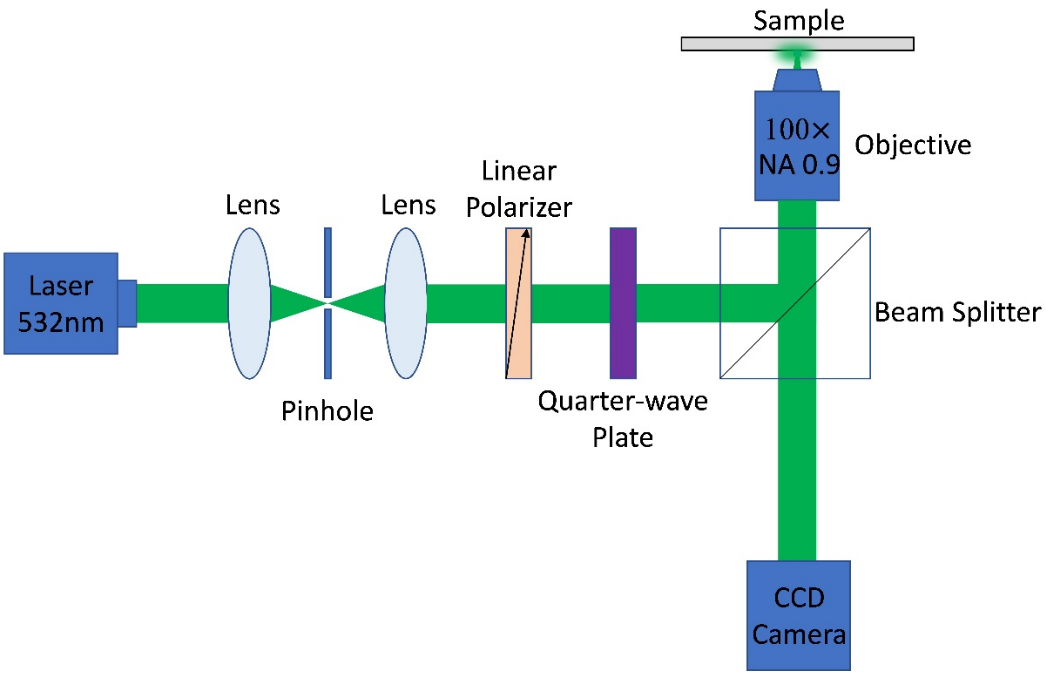

Figure S3. Experimental setup for characterizing emission properties of samples. A 532 nm laser beam is collimated by a set of lenses and pinhole, and passes a linear polarizer and a quarter-wave plate, resulting in continuously varied polarization states between LP, RCP and LCP by adjusting the orientation angle of quarter-wave plate with respect to linear polarizer. Afterwards, the beam is tightly focused onto the sample by an objective. The reflected signal is imaged onto a CCD camera.