Electronic Supplementary Material (ESI) for Nanoscale

Supporting information

Photoluminescence Via Gap Plasmons Between Single Silver Nanowires And A ThinGold Film

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Supporting Figures

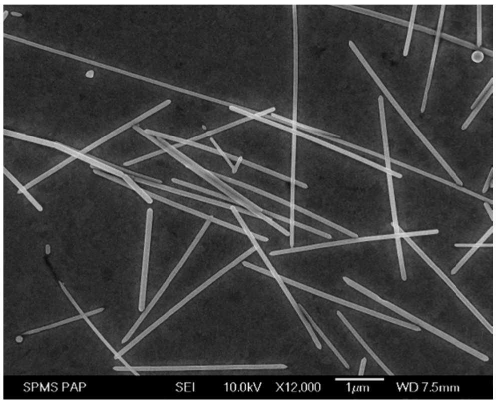


Figure S1.SEM image of chemically synthesized silver nanowires with a range of diameters and lengths.

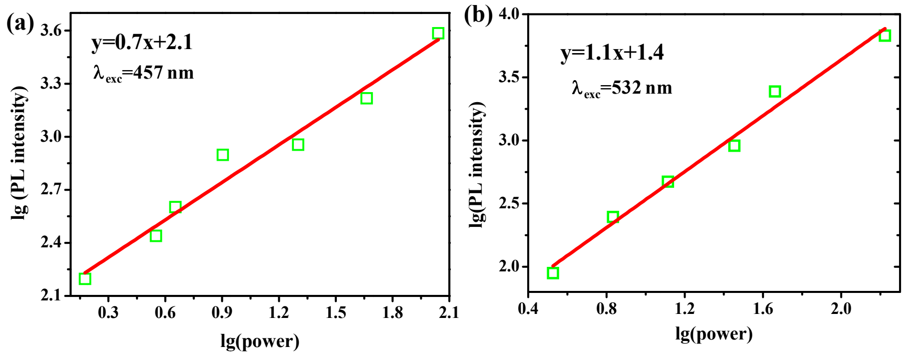


Figure S2. Power dependence of photoluminescence of Ag nanowire-Au film under 457(a) and 532(b) nm excitations, showing that the luminescence is single-photon process.

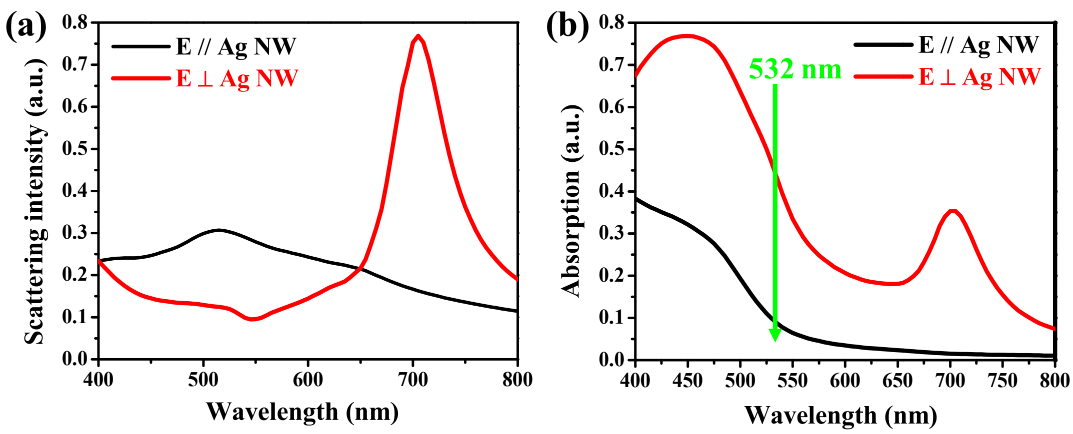


Figure S3. Simulated spectra for (a) scattering and (b) absorption of the 350nm wide part of the

Au film underlying the nanowire for the 84 nm Ag nanowire-Au film structure. The spectra obtained under the parallel and perpendicular polarizations show good agreement with the experimental measurements. The differences in optical absorption for two polarizations observed for 532 nm photons cause the anisotropy of photoluminescence intensity from the gap plasmon resonance.

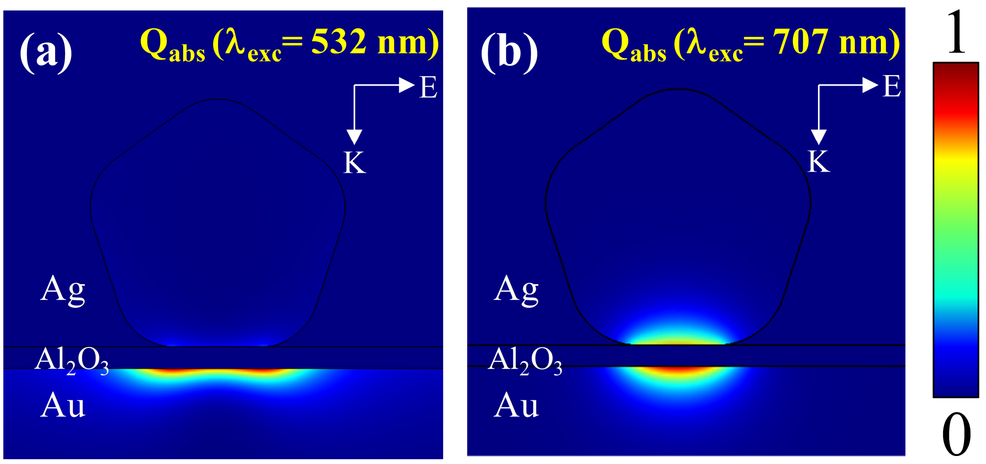
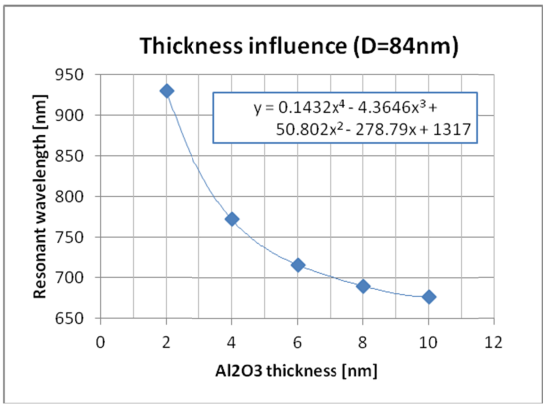
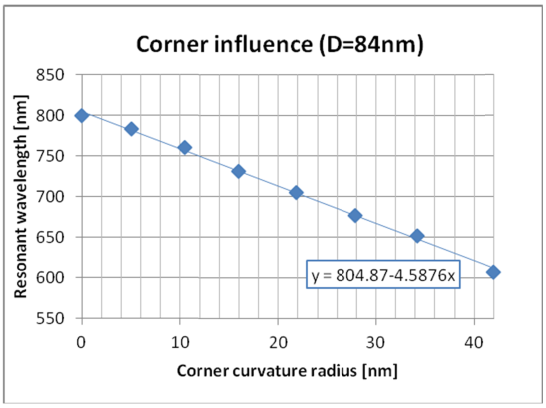


Figure S4. Absorbed power density distribution of Ag nanowire-on-film structure under the normal incidence of (a) 532 and (b) 707 nm photons, corresponding to the laser wavelength and the gap plasmon resonance, respectively. The strongest photon absorption for the excitation wavelength used in our experiments, i.e. 532 nm, is localized in the Au film under the Ag nanowire. At the gap plasmon resonance, i.e. 707 nm, there still are heating losses within both Au and Ag.





FigureS5. (Left) Simulation results showing the effect of gap size (Al_2O_3 thickness) on the resonant wavelength of the gap plasmon for a nanowire with a width D = 84 nm and corner radius of curvature = 22 nm. Increasing gap size reduces the effective refractive index and thus leads to a blueshift in the resonance. **(Right)** Simulation results showing the effect of the corner radius on the gap plasmon resonant wavelength for D = 84 nm and Al_2O_3 thickness = 6.5 nm.

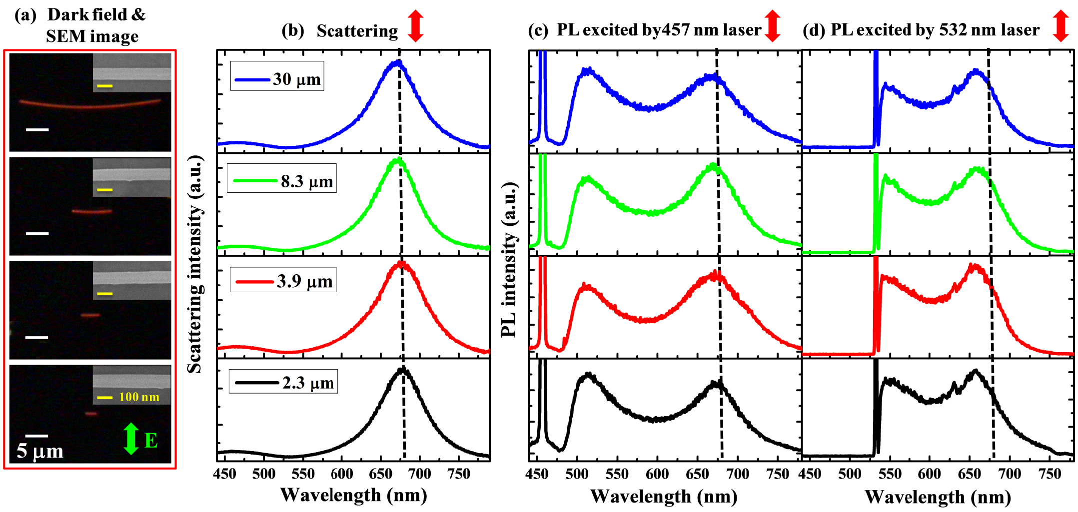


Figure S6. (a) Dark field optical and SEM images of four Ag nanowires on Au film. These nanowires have uniform red color under the excitation of perpendicularly polarized white light. The SEM images show that these nanowires have identical diameter of 88 nm but different lengths ranging from 2.3 to 30 µm. (b) The corresponding scattering spectra of these four wires exhibit strong resonant peaks almost at the same wavelength of 677 nm, indicating that the gap plasmon resonance is independent upon the length of wire. (c)and (d) represent the correlated photoluminescence spectra of these four nanowire-film structure under 457 and 532 nm excitations, demonstrating the PL peaks at 670 and 658 nm, respectively. The similarity in length independence of PL peak position further suggests the exact PL origin from the hybridized plasmon mode.

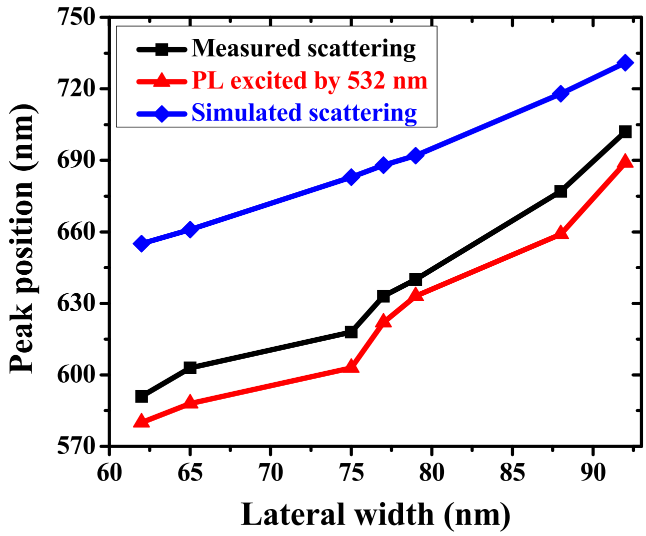


Figure S7. The comparison of peak position of PL and scattering spectra, demonstrating similar tendency with increasing width of nanowire and a close follow with our experimental results. Discrepancies between simulated (blue) and experimental results (red and black) could be due to surface roughness of the gold film.