## Supporting Information for

## Nanoporous Gold Nanoparticles and Au/Al<sub>2</sub>O<sub>3</sub> Hybrid Nanoparticles with large Tunability of Plasmonic Properties

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**Figure S1.** (a) Histograms of the particle size distribution of the 4 types of NPG-NPs in Fig. 1, the values m and  $\sigma$  denote the mean particle diameter and its standard deviation. (b) Plots of radially averaged autocorrelation function of the induced particles, arrows indicate the corresponding characteristic particle spacing (at first maximum).



**Figure S2.** (a) left panel: histograms of the ligament size (diameter) distribution of the 4 types of NPG-NPs in Fig. 1, and (b) right panel: histograms of the pore size (pore channel diameter) distribution of the 4 types of NPG-NPs in Fig. 1. The values  $d_l$ ,  $d_p$  and  $\sigma$  denote the mean ligament size, mean pore size and their standard deviation.



**Figure S3.** EDS spectrum of the NPG-NP. Inset is the SEM image of the investigated NPG-NP. The orange square in the SEM image is the selected area for the EDS investigation. The strong Si and O signal were from the substrate.



**Figure S4.** The peak position of dipole plasmon mode versus particle diameter. Data extracted from Figure 3 and Figure 4.



**Figure S5.** Polarization vectors of solid gold NPs (D = 393 nm) for dipole, quadrupole and octupole resonances at 1100, 620 and 535 nm, respectively.



**Figure S6.** (a) Calculated extinction spectra of spherical NPG-NPs (D = 233 nm) of various volume porosities. (b) The relationship between the wavelength of plasmon mode peak and the volume porosity of the NPG-NPs. (c) The intensity ratio of dipole mode and quadrupole mode plotted as a function of the volume porosity of the NPG-NPs. The pore size is fixed at 20 nm. The volume porosities of the NPG-NPs are 0%, 10%, 20%, 30%, 40%, 50%, 60% and 66%, respectively.



**Figure S7.** (a) left panel: histograms of the ligament size (diameter) distribution of the 3 types of NPG-NPs in Fig. 6, and (b) right panel: histograms of the pore size (pore channel diameter) distribution of the 3 types of NPG-NPs in Fig. 6. The values  $d_l$ ,  $d_p$  and  $\sigma$  denote the mean ligament size, mean pore size and their standard deviation.



**Figure S8.** (a) Calculated extinction spectra of spherical NPG-NPs (D = 233 nm) of various pore sizes. (b) The relationship between the wavelength of plasmon mode peak and the pore size of the NPG-NPs. (c) The intensity ratio of dipole mode and quadrupole mode plotted as a function of the pore size of the NPG-NPs. The volume porosity of the NPG-NPs is fixed at 66%. The pore sizes are 20, 40, 60, 80 and 100 nm, respectively.



**Figure S9.** (a) SEM image of a cross-sectioned Au/5nm-Al<sub>2</sub>O<sub>3</sub> hybrid porous NP, (b) EDS mapping of Al, and (c) EDS mapping of Au.