Supplementary Information

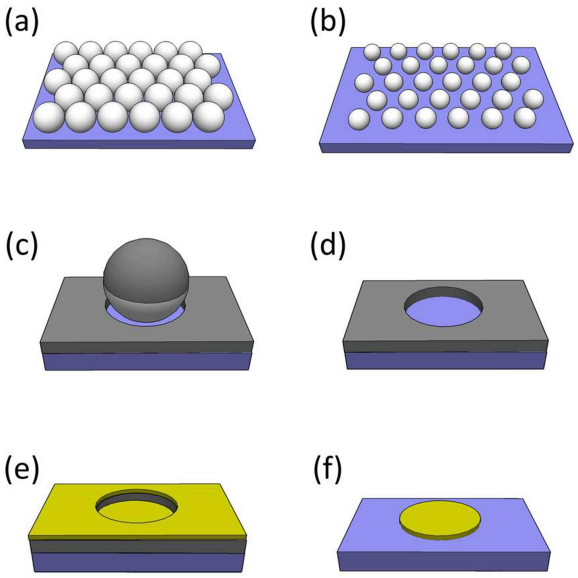

Figure S1

Nanodisk fabrication schematic illustration. (a) Hexagonal close packed monolayer of polystyrene nanospheres was formed on the quartz substrate via spin coating. (b) Size of nanospheres was reduced by dry etching. (c) Nickel was evaporated on the nanosphere coated substrate, which form a thin layer of nickel with nanoholes around polystyrene nanospheres. (d) Nanospheres were removed using Scotch tape. (e) Titanium as adhesion layer followed by gold were vapor-deposited on the substrate. (f) Finally, nickel layer was removed using nitric acid. $MoSe_2$ flakes were then transferred on this Au nanodisks array.

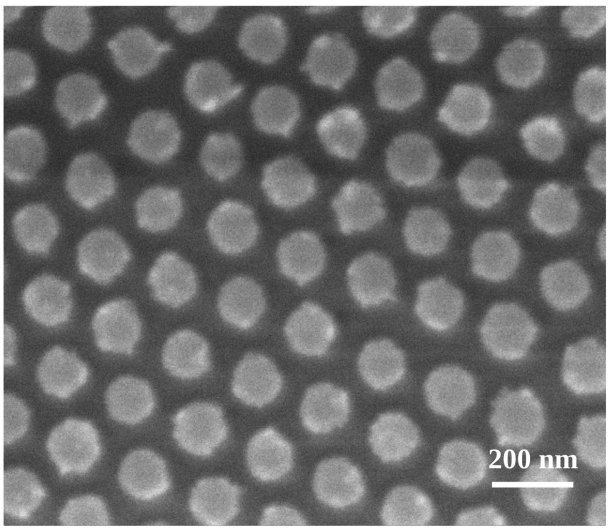

Figure S2

Scanning Electron Microscopy image (x 100 000 magnification) of Au nanodisks array fabricated using the shaped nanosphere lithography process. The center to center separation between the disks is around 190 nm and the average diameter of the disks is 140nm.

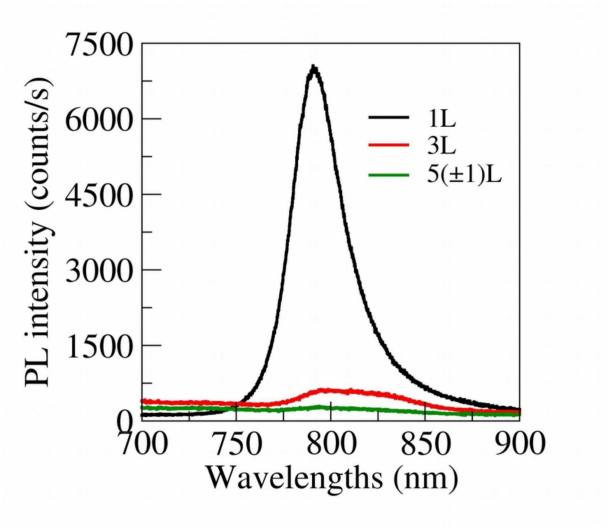

Figure S3

Photoluminescence spectra of 1, 3 and 5 (± 1) monolayers of $MoSe_2$@Au recorded, respectively, at locations b, c and d shown in the optical image in Figure 7. Photoluminescence was excited using the 532 nm laser line.

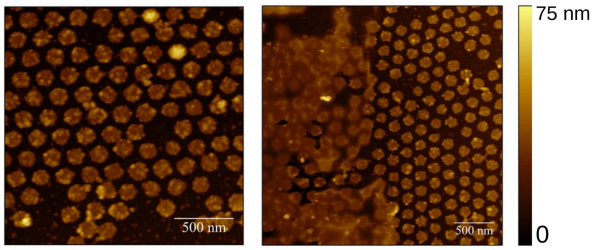

Figure S4

AFM images of bare Au disks (left) and $MoSe_2$ coated Au disks (right) showing the typical size, corrugation and spacing fluctuations observed in the Au disks array.

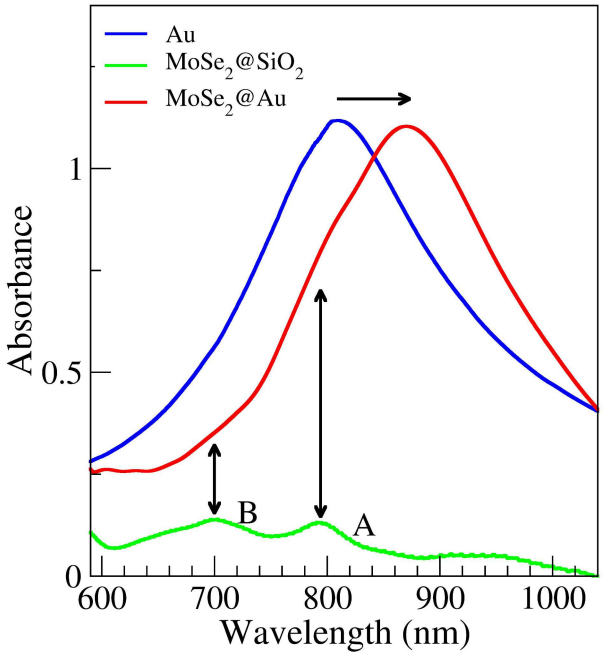

Figure S5

Optical absorbance spectra of $MoSe_2$@Au and bare Au disks on a different sample with an average disk size and separation of 190 nm and 20 nm, respectively. The vertical arrows indicate the wavelengths of the A and B excitons. The horizontal arrow highlights the shift of $MoSe_2$@Au LSPR (872 nm) with respect to that of bare Au (810 nm). As a result of the stronger interaction between the disks, the LSPR of $MoSe_2$@Au is red-shifted with respect to the A exciton, which results in a weaker surface plasmon-exciton interaction and no signature of Fano-type interference is observed.

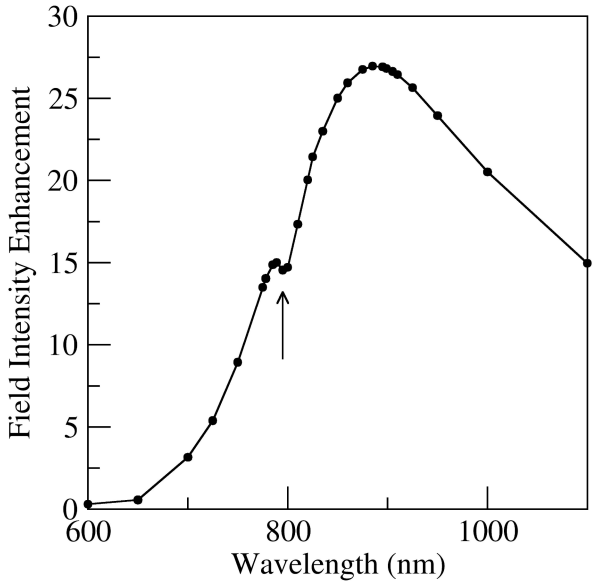

Figure S6

DDA near-field intensity spectrum calculated inside the $MoSe_2$ layer in the gap region between two Au nanodisks (see schematic illustration in Figure 4). As already observed in the far-field spectra, a minimum is clearly evidenced at the wavelength of the transparency dip (arrow at 795 nm) due to Fano-type interference.

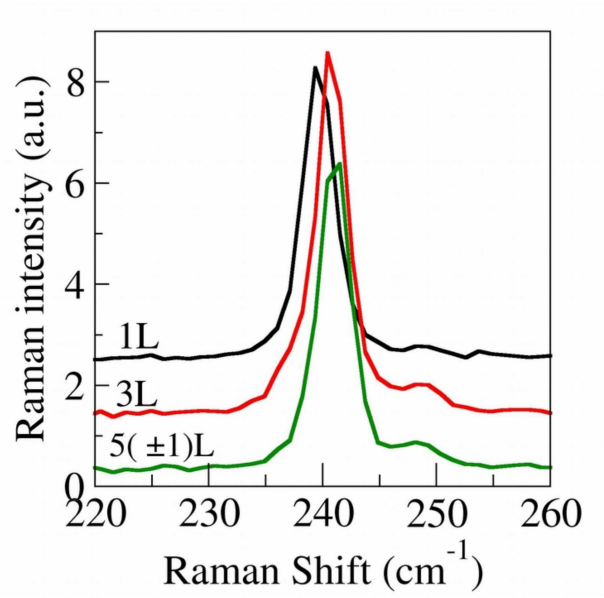

Figure S7

Raman scattering spectra of 1, 3 and 5 (± 1) monolayers of $MoSe_2$@Au recorded, respectively, at locations b, c and d shown in the optical image in Figure 7. The Raman scattering was excited using the 532 nm laser line.