Hollow Gold Nanorectangles: The Roles of Polarization and Substrate

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A representative DDA vector plot is shown in Figure S1.

DDA extinction spectra for the full set of interparticle separations for the hollow rectangles in air with long orientation are shown in Figure S2.

Experimental extinction spectra for the full set of interparticle separations for the hollow rectangles with long orientation are shown in Figure S3.

Ten raw experimental extinction spectra for hollow rectangles with long orientation, an interparticle separation of $27 \pm 2$ nm and light polarized parallel to the interparticle axis are shown in Figure S4.

DDA extinction spectra for the full set of interparticle separations for the hollow rectangles on a substrate with long orientation are shown in Figure S5.

Composite field plots for an isolated particle on a substrate at 1220 nm and 1340 nm with parallel polarization are shown in Figure S6.

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Composite field plots for a particle pair with an interparticle separation of $27\pm2$ nm on a substrate are shown in Figure S7.
Figure S1. Representative field vector plot (top slice of a hollow rectangle) for an isolated hollow rectangle in air with a) parallel polarization at $\lambda = 936\text{nm}$ b) perpendicular polarization at $\lambda = 844\text{nm}$ and c) perpendicular polarization at $\lambda = 574\text{nm}$. As shown, a plus sign will indicate when all the
vectors are pointing towards an area, and a minus sign indicate when all the vectors are pointing away from an area.

Figure S2. DDA extinction spectra for hollow gold nanorectangles with long orientation in air (i.e. no substrate) and light polarized a) parallel and b) perpendicular to the interparticle axis (as indicated in the insets). The interparticle separations are indicated in the legend. The spectra show the expected red shift and blue shift for parallel and perpendicular polarization, respectively.
Figure S3. Experimental extinction spectra for hollow gold nanorectangles with long orientation and polarization a) parallel and b) perpendicular (as indicated in the insets) to the interparticle axis. The interparticle separations are indicated in the legend. There are two distinct peaks present for the parallel polarization, which red shift and change in intensity as the interparticle separation decreases. For the perpendicular polarization the expected blue shift is seen as the interparticle separation decreases.
Figure S4. Ten raw experimental extinction spectra for hollow gold nanorectangles with an interparticle separation of $27 \pm 2$ nm long orientation and polarization parallel to the interparticle axis. The spectra are very similar to one another, indicating good uniformity across the entire sample. The main peak position occurs at 1496 nm with a relative standard deviation of only 0.5%.
Figure S5. DDA extinction spectra for hollow gold nanorectangles with long orientation on a substrate light polarized a) parallel and b) perpendicular to the interparticle axis (indicated in the insets). The interparticle separations are indicated in the legend.
Figure S6. Composite field plot for isolated particle on a substrate. a) Parallel polarization at 1220 nm. The field is located at the corners of the particle in each slice. The field vectors are pointing away from the right of the particle and towards the left in each slice. The field location and orientation indicates this is the dipole mode. b) Parallel polarization at 1340 nm. The field is located at the corners of the particle in each slice. The field vectors are pointing away from the right of the particle and towards the left in each slice. The field location and orientation indicates this is the dipole mode.
Figure S7. Composite field plot for particle pair with an interparticle separation of 27±2 nm on a substrate. a) Perpendicular polarization at 680 nm. The field is located at the corners and sides of
the particle in each slice. The field vectors are pointing away from the front corners and middle of the back slide and towards the back corners and middle of the front side. The field location and orientation indicates this is the higher order multipole mode. The field is most intense at the bottom slice of the particle. b) Perpendicular polarization at 1110 nm. The field is located at the corners of the particle in each slice. The field vectors are pointing away from the back of the particle and towards the front in each slice. The field location and orientation indicates this is the dipole mode. The field is most intense at the bottom slice of the particle. c) Perpendicular polarization at 1420 nm. The field is located at the corners of the particle in each slice. The field vectors are pointing away from the back of the particle and towards the front in each slice. The field location and orientation indicates this is the dipole mode. The field is most intense at the middle slice of the particle.