

## High spatial and energy resolution electron energy loss spectroscopy of the magnetic and electric excitations in plasmonic nanorod oligomers: supplement

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# High Spatial and Energy Resolution Electron Energy Loss Spectroscopy of the Magnetic and Electric Excitations in Plasmonic Nanorod Oligomers: Supplemental Information

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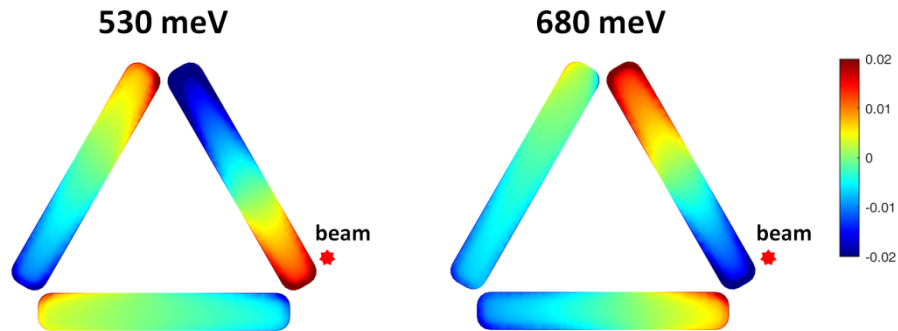


Fig. S1. Charge distribution of the two LSPRs of the  $n=3$  polygon calculated using the full Maxwell's equations solution. The modal decomposition of the Green function we used in the main text is only possible within the quasistatic approximation. The size of the metallic structures we consider in this paper is however above the validity limit of the approximation. In order to check the consistency of our results we also solved the full Maxwell's equation, including retardation effects, and calculated the charge distributions for the two main modes of the  $n=3$  polygon. Despite the size of the system, the results obtained with the two levels of approximations are in good qualitative agreement.

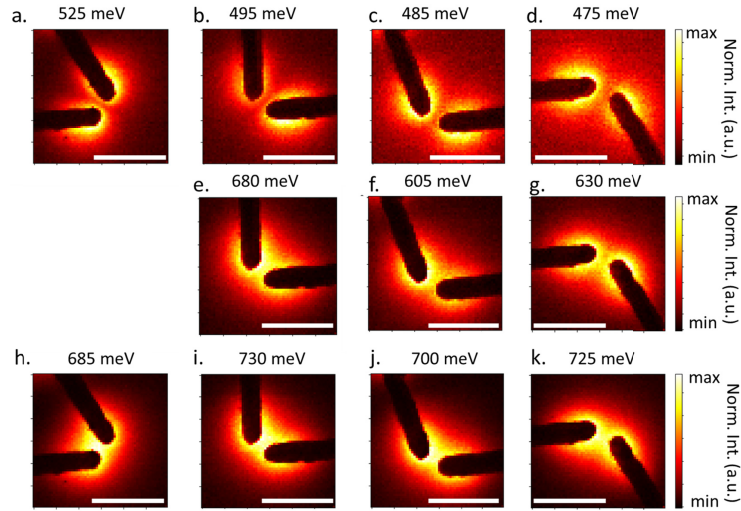


Fig. S2. Spectrum images for the  $n=3,4,5,6$  arrangements illustrating the a-d) magnetic mode, e-f) intermediate mixed mode, and h-k) antibonding mode. Scale bar = 300 nm

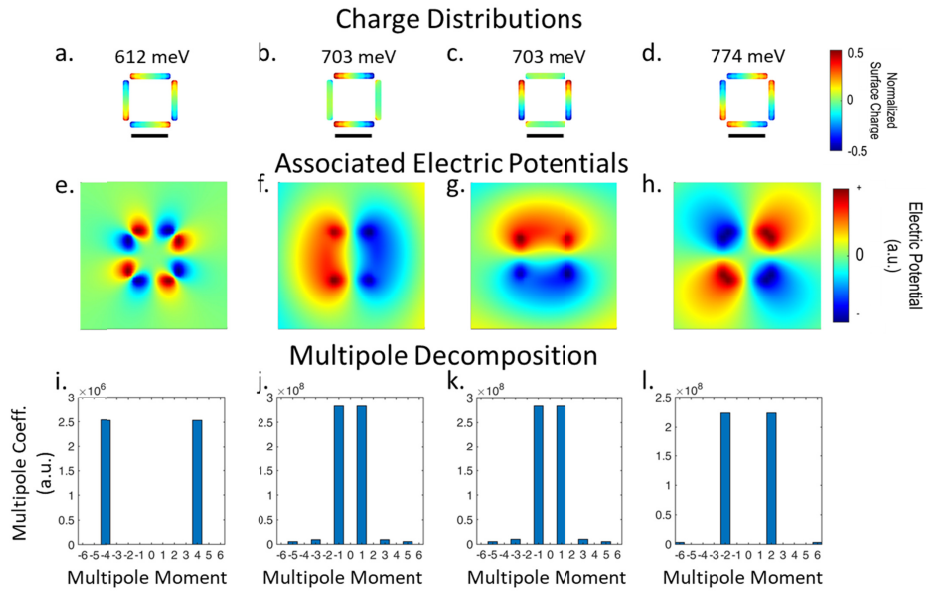


Fig. S3. The complete list of the plasmonic modes of the  $n=4$  polygon with energy in the range [300-1000] meV. a-d) Charge distributions, e-h) the associated electric potentials and i-l) the multipolar decomposition of the potential associated with each mode. It is worth noticing the 2 degenerate modes at 663 meV and their identical multipolar decomposition. The difference between the two modes is in fact only a  $90^\circ$  rotation. Which one of the two modes is excited (or what linear combination of the pair) depends on the position of the electron beam. Scale bar = 500 nm.

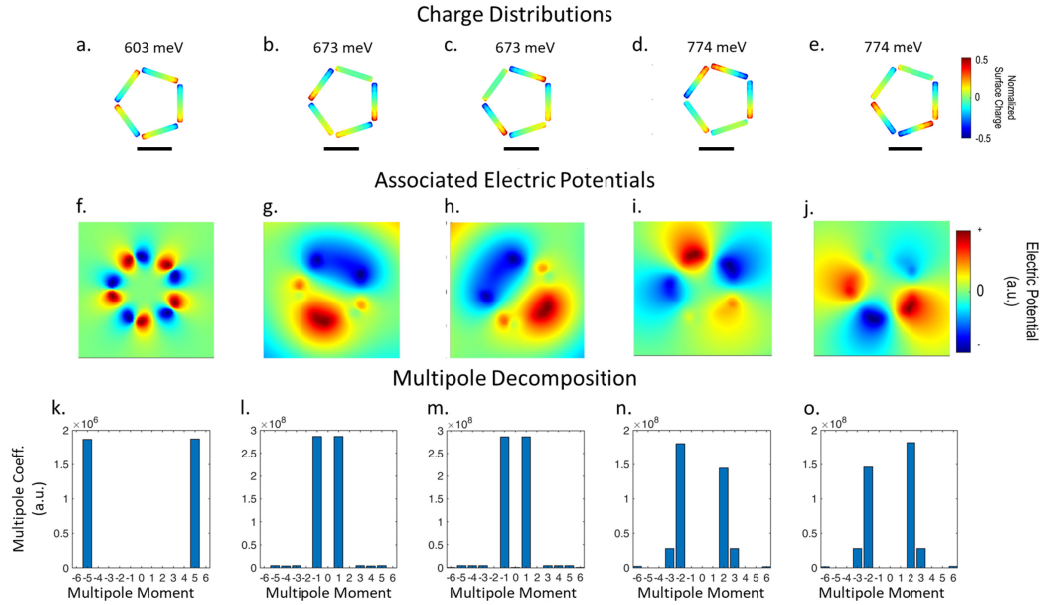


Fig. S4. The complete list of the plasmonic modes of the  $n=5$  polygon with energy in the range [300-1000] meV. a-e) The charge distributions, f-j) the associated electric potentials and k-o) the multipolar decomposition of the potential

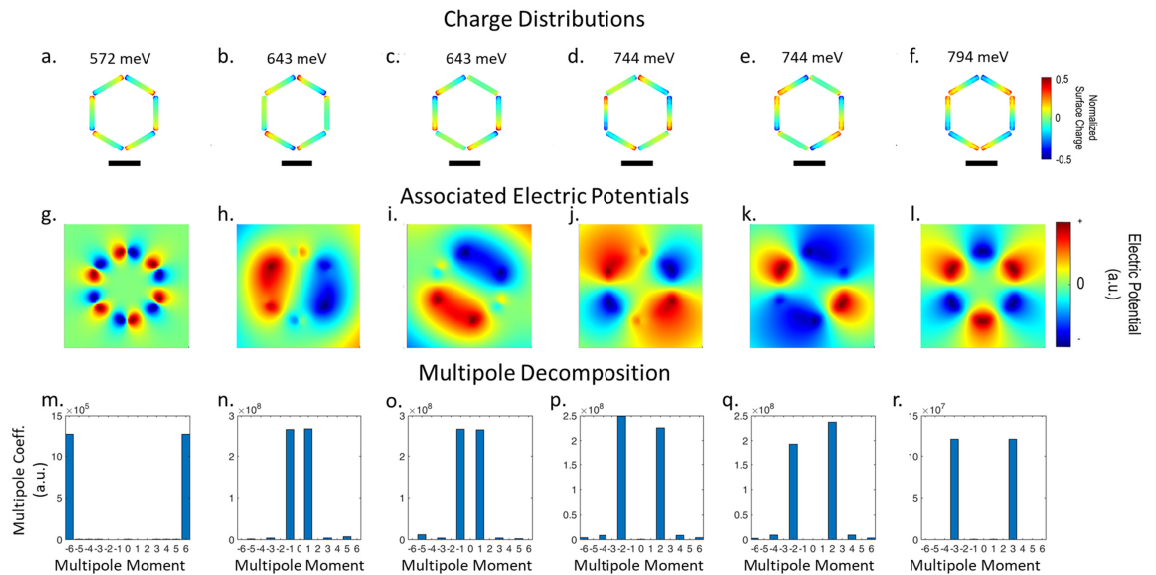


Fig. S5. The complete list of the plasmonic modes of the  $n=6$  polygon with energy in the range [300-1000] meV. a-f) The charge distributions, g-l) the associated electric potentials and m-r) the multipolar decomposition of the potential associated with each mode. It is worth noticing

the 2 pairs of degenerate modes at 642 meV and 743 meV. The difference between the two modes in every pair is a  $60^\circ$  rotation. Which one of the two modes is excited (or what linear combination of the pair) depends on the position of the electron beam.

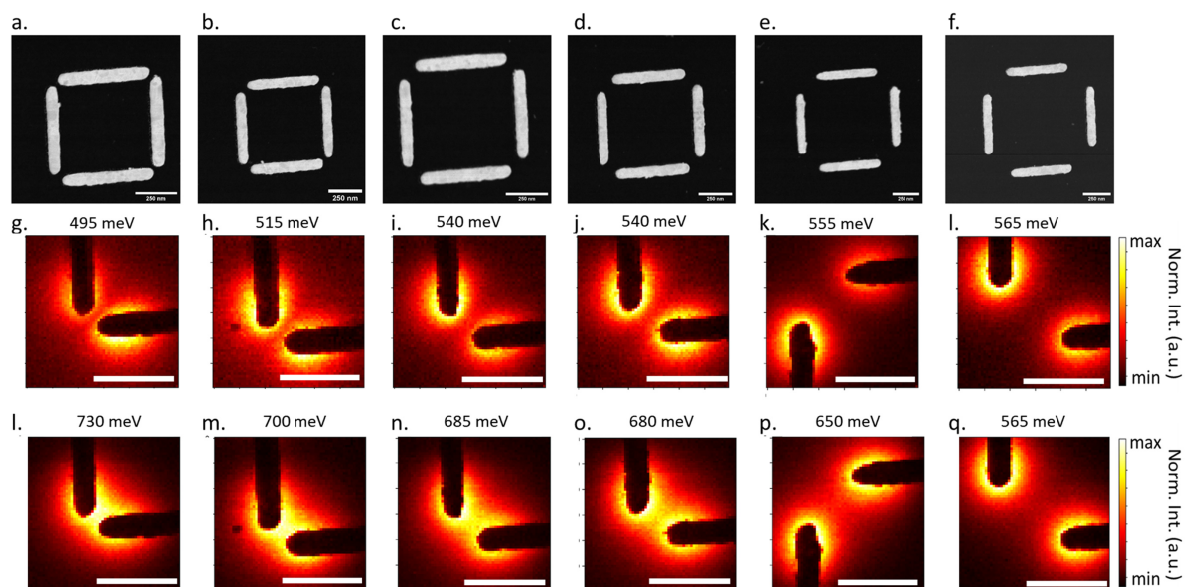


Fig. S6. a-f) HAADF images of the synthesized polygons with variable gap sizes. g-l) Spectrum images filtered at the magnetic dipole for the various gap sizes. k-g) Spectrum images filtered at the full antibonding mode various gap sizes. Scale bar=300 nm

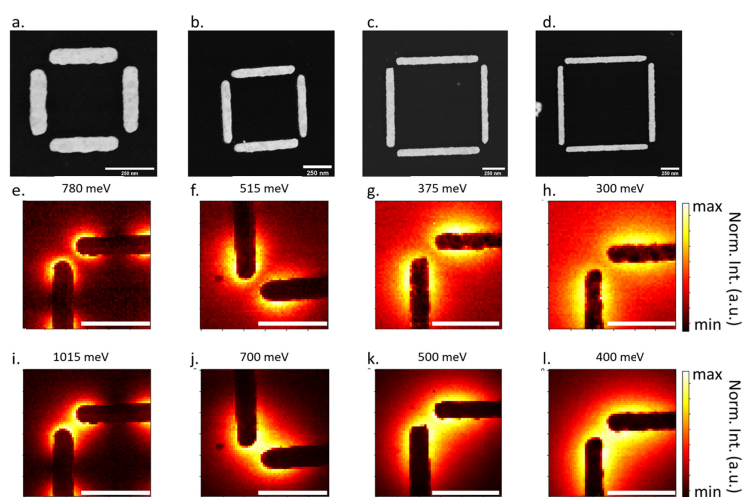


Fig. S7. a-d) HAADF images of the synthesized tetramers with variable edge length and e-h) Spectrum images filtered at the magnetic dipole for the n=3-6 polygons. i-l) Spectrum images filtered at the full antibonding mode for each length. Scale bar=300 nm