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Three-dimensional Chiral Plasmonic Oligomers

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We demonstrate chiral optical response in stacked arrangements of plasmonic nanostructures. We show that three-dimensional arrangements of plasmonic "meta-atoms" only exhibit a chiral optical response if similar plasmonic "atoms" are arranged in a handed fashion as we require resonant plasmonic coupling. Moreover, we demonstrate that such particle groupings, similarly to molecular systems, possess the capability to encode their three-dimensional arrangement in unique and well-modulated spectra, making them ideal candidates for a three-dimensional chiral plasmon ruler. Furthermore, we discuss the onset of a broadband chiral optical response in the wavelength regime between 700 nm and 3500 nm upon charge transfer between the nanoparticles. We show in experiment and simulation that this response is due to the ohmic contact between adjacent particles which causes a strong red-shift of the fundamental mode. The geometrical shape of the resulting fused particles allows for efficient excitation of higher order modes. Calculated spectra and field distributions confirm our interpretation and show a number of interacting plasmonic modes. Finally, we will discuss plasmonic diastereomers which consist of multiple chiral centers. We find that the chiral optical response of the composite molecules can be traced back to the properties of the constituting building blocks. We demonstrate that the optical response of complex chiral plasmonic systems can be decomposed and understood in terms of fundamental building blocks, offering simple and straightforward design rules for future applications such as chiral optical elements and enantiomer sensors.