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Plasmonic nanoantenna arrays for surface enhanced vibrational spectroscopy of proteins RONEN ADATO, AHMET YANIK, ECE, Boston Univ., Boston, MA, JASON AMSDEN, DAVID KAPLAN, FIORENZO OMENETTO, BME and Physics, Tufts Univ., Medford, MA, MI HONG, SHYAMSUNDER ERRAMILLI, Physics and BME, Boston Univ., Boston, MA, HATICE ALTUG, ECE, Boston Univ., Boston, MA — Infrared absorption spectroscopy enables direct access to vibrational fingerprints of molecular bonds in the mid-infrared spectral region (3-20μm). Although intrinsic absorption cross-sections are nearly 10 orders of magnitude larger than corresponding Raman cross-sections, they are still small in comparison with those of fluorescent labels. Sensitivity improvements are required for the method to be applicable to single molecule / monolayer studies. Here we present work demonstrating the use of lithographically patterned arrays of nanoantennas to enhance the absorption signature of the protein Amide-I and II backbone vibrations. By examining both periodic and disordered antenna arrays, we observe the effect of diffractive coupling on the collective array resonances and the role in absorption enhancement. Specifically, we show that the higher quality factor resonances achievable with periodic arrangements can result in significant enhancements in absorption signals. By tuning array periodicity, we show that signals can be enhanced 10^4-10^5 fold, leading to the direct measurement of vibrational spectra of proteins at zepto-mole sensitivity levels.

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