ENHANCED SURFACE ABSORPTION SPECTRA USING THE EXTRADORINARY TRANSMISSION OF METALLIC ARRAYS WITH SUBWAVELENGTH HOLES: THE SNYDER METHYLENE WAGGING PROGRESSIONS OF ALKANETHIOL SELF-ASSEMBLED MONOLAYERS

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Metallic microarrays have been developed that exhibit resonant transmissions across the infrared range of fundamental molecular vibrations. These meshes transmit more light than is incident upon their holes due to the excitation of surface plasmons (SPs). The SPs propagate along the surface until they tunnel through a hole, reemerging as photons on the other side of mesh, without being scattered out of the incident beam. This arrangement offers a long effective pathlength for absorption by molecules on the surface. These meshes are first coated with copper and then coated with self assembled monolayers of alkanethiols which exhibit infrared absorption spectra that are more than 100-fold enhanced over literature reports. We present high quality spectra with linewidths less than 3 cm^{-1} of a sequence of alkanthiolates of longer hydrocarbon chain length. Progressions of the all trans CH_2 wagging vibrations (Snyder progressions) are observed which depend explicitly on the length of the chains. A fit is presented which predicts these progressions at any chain length and connects these results to those of an infinite length hydrocarbon chain.