Second Harmonic Generation from Nanocylinders: from a Single Nanocylinder to a Nanocylinders Array

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There has been in the literature an extensive study of the linear and nonlinear optical properties of metallic nanostructures. These works have principally focused on the origin of the response on the one hand and on the surface plasmon resonances engineering on the other hand. Nevertheless, some issues remain like the building of a coherent SHG response of an array of nanostructures from its individual constituent nanostructures.

To address this question, we have recorded the Second Harmonic Generation intensity of individual gold nanocylinders forming a square array, see Figure 1. This study has been performed as a function of the input polarization angle in order to generate polarization resolved plots of the SHG response. A common bias towards a defined polarization direction is detected for each single nanocylinders, suggesting that SHG is a perfect tool to assess the quality of a metallic nanostructures array. Besides, this study also indicates that the origin of the SHG response of the nanocylinders stems from shape defects breaking the centrosymmetry of these otherwise centrosymmetric nanostructures.

![Figure 1: SHG Intensity map of an array of 100 nm diameter gold nanocylinders.](image)

In a second step, we have observed the SHG response from a square array of the gold nanocylinders. The overall response of the array presents a similar bias towards the same defined input polarization direction as the individual nanocylinders, resulting from the superposition of the individual gold nanocylinders response. Also, due to the origin of the response, no coherent response may develop in transmission geometry at normal incidence. Such a coherent response can only be obtained when a tilt of the sample plane with respect to the normal incidence is introduced due to the emergence of the nonlinearity contribution due to the interface between the gold nanocylinders and the substrate [1].

References