



ID de Contribution: 19

Type: Oral presentation

## SHG origin in Gold Nanoantennas

*jeudi 18 mars 2021 17:00 (20 minutes)*

Second harmonic generation (SHG) is a nonlinear optical process that has been the basis of applications including frequency-doubling of laser sources, characterization of materials and it has also been a subject of fundamental research interest since decades.

Within this context, nonlinear plasmonics is one sub-domain of nanophysics wherein nonlinear optical processes such as SHG are generated and enhanced at the nano-scale using plasmonic nanostructures. While the theory of SHG in metals have been formulated since more than a few decades, the role played by certain second harmonic (SH) contributions in metal nanostructures has not been rightly attributed to SHG and has therefore resulted in sizeable disagreement in the literature.

In order to solve this longstanding problem, here, we investigate SH contributions via numerical simulations and compare them with the experimentally obtained SH response of gold nanostructures, in particular, rectangular double antennas and prism antennas.

The simulations are based on finite element methods wherein response due to individual SH contributions are obtained separately and followed by coherently summing up these contributions to account for constructive and destructive interferences among the nonlinear processes. On the experimental side, antennas are fabricated by electron beam lithography and chemical synthesis in order to investigate surface roughness and crystallinity which is believed to play an important role in SH contribution. The SH measurement is then performed on the antennas via an experimental setup developed to reach single particle sensitivity.

Thus in this regard, we are able to precisely identify and attribute the role of SH components in SHG from plasmonic nanoantennas by comparing the maps generated from the simulations and experiments.

### References

- [1] Bachelier, G. et al, PRB, Vol. 82, 2010.
- [2] Ethis de Corny, M. et al, ACS Photonics, 3 (10), pp 1840–1846, 2016
- [3] N.Chauvet et al, ACS Photonics, 7, 3, pp 665–672, 2020

### Language

English

### Field

Nonlinear Plasmonics

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**Classification de Session:** Oral presentations session

**Classification de thématique:** Physics