Circular magnetoplasmonic modes in noble metal and hybrid nanoparticles

F. Pineider[1,2], V. Bonanni[1], G. Campo[1,3], C. de Julián Fernández[4], G. Mattei[5], M. Gurioli[6], C. Sangregorio[1,7]

1 - Department of Chemistry, University of Florence & INSTM, 50019 Florence, Italy
2 - CNR-ISTM Padova, 35131 Padova, Italy
3 - CNR-INO-UOS Firenze LENS, Via N. Carrara 1, 50019 Sesto Fiorentino (FI), ITALY
4 - CNR-IMEM, 43124 Parma, Italy
5 - Department of Physics, University of Florence, 50019 Florence, Italy
6 - Department of Physics, University of Padova, I-35131 Padova, Italy
7 - CNR- ICCOM Sesto Fiorentino, 50019 Florence, Italy

francesco.pineider@unifi.it

The controlled and reversible modification of the optical response of plasmonic systems, -active plasmonics- is a highly prized goal in today's research in materials science and nano-optics, due to an attractive potential for high-tech applications, from ultrasensitive refractometric sensing, to switchable plasmonic optical circuits. Magnetoplasmonics is the branch of active plasmonics that uses a magnetic field to influence surface plasmon resonance. [1] Currently, great efforts are being devoted to fully understanding the nature and effect of such interaction, with the ultimate goal of increasing its magnitude through rational design.
I will show how ordinary gold nanoparticles' optical properties are modified by the magnetic field and describe the origin of such magnetoplasmonic behavior. [2] Magneto-optical spectroscopy proved an invaluable tool to study this effect, and to give an experimental comparison to theoretical model: using a circular base to describe plasmons in fact, it is possible to relate the experimental behavior to a simple and elegant quantitative model.
However, the effect of the magnetic field on non-magnetic plasmonic materials –such as gold or silver– is rather small: building on our understanding of the phenomenon, in order to try and boost this effect we have been working on colloidal hybrid nano-architectures in which a magnetic moiety flanks the plasmonic one. Using a combined approach with the aid of magnetometry and magneto-optics at high magnetic field, we investigated several routes to design magnetic-plasmonic hybrid nanoparticles containing gold and iron oxides with different geometries, exhibiting different levels of conjugation, thus a variable extent of interaction of the magnetic and plasmonic functions. We found that the chemical composition of the magnetic part critically affects the synergy of the two moieties; this finding paves the way to a largely rational design of material candidates for magnetoplasmonics.
This work has been financed by the Italian MIUR through FIRB projects “NanoPlasMag” (RBFR10OAI0) and “Rete ItalNanoNet” (RBPR05JH2P), by the EC through FP7-214107-2 NANOMAGMA, FP7-NMP4-LA-2008-213631 NANOTHER and ERC Advanced Grant “MolNanoMas” (267746), and by Fondazione Cariplo through Project No. 2010-0612.

References

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Figures