



Friday 2nd February 2024 at 11:30 in room F

Prof. Tommaso Del Rosso

Department of Physics
Pontifical Catholic University of Rio de Janeiro

will give the talk entitled:

Pulsed laser driven fixation of CO₂ into advanced functional nanomaterial for photonic and biological application

Your presence is welcome

Pulsed laser driven fixation of CO₂ into advanced functional nanomaterial for photonic and biological application

Prof. Tommaso Del Rosso

Department of Physics of the Pontifical Catholic University of Rio de Janeiro

Rua Marques de São Vicente 225, 22451-900, Rio de Janeiro, Brazil

e-mail: tommaso@puc-rio.br

The CO₂ reduction reaction is up today exploited for the synthesis of value-added feed-stocks in gaseous or liquid form [1]. Here we report an example of CO₂ reduction reaction leading to the production of advanced functional nanomaterial by the use of pulsed laser irradiation of a gold target in water. The presence of CO₂ derivatives in water during the ablation process, leads to C₂ and C₃ coupling with the production of organic material with the typical fingerprint of the CO₂ reduction reaction. By the pulsed laser driven CO₂ reduction reaction, we are able to obtain ultra-small AuNPs (d < 3 nm) and photoluminescent metal-organic nanocomposites with a quantum-yield of the about 23% in the blue spectral region [2,3]. The CO₂ reduction reaction controls also the biological effects of the produced nanomaterial in endothelial colony forming cells, with the possibility to switch from anti-angiogenic to pro-angiogenic regulators. In the latter case, the biomolecular signaling indicates the ability to behave as carbon monoxide releasing gold nanoparticles [4,5], inducing a strong pro-angiogenic activity, demonstrated by both *in vitro* and *in vivo* experiments.

- [1] F. Creutzig et Al., "The mutual dependence of negative emission technologies and energy systems", *Energy Environ. Sci.*, 12, 1805-1817 (2019)
- [2] A.R Ziefuss et Al., "Photoluminescence of Fully Inorganic Colloidal Gold Nanocluster and Their Manipulation Using Surface Charge Effects", *Adv. Mater.*, 2101549 (2021)
- [3] T. Del Rosso, Tahir et Al., "Pulsed laser driven CO₂ reduction reaction for the control of the photoluminescence quantum yield of organometallic gold nanocomposites", in revision in *Small Science*
- [4] R. Motterlini, L.E. Otterbein, "The therapeutic potential of carbon monoxide", *Nat Rev Drug Discov* 9, 728–743 (2010)
- [5] A. Chillá et Al., "Carbon Monoxide-Rich Gold Nanoparticles: Pioneering a Novel Therapeutic Avenue for Endothelial Tissue Regeneration", in revision in *Nanotoday*

Short bio

Bachelor's in Physics and PhD in Telecommunication and Electric Engineering from the *Università degli Studi di Firenze*. His recent interests include the fabrication and investigation of the optical and spectroscopic properties of metal-organic interfaces, in the form of thin films or nanoparticles. The experimental expertise includes SPR spectroscopy, Surface Enhanced Raman Scattering, Pulsed Laser Ablation and photoluminescence. The most relevant applications include thin film optical devices, and external collaborations in the sector of nanomedicine. He is Professor and responsible of the *NanoLaserLab* in the Department of Physics of the *Pontifícia Universidade Católica do Rio de Janeiro* (PUC-Rio).

