Molecular and Metal-Complex Engineering for Advanced Nonlinear Photonic Materials

Said Taboukhat,[1*] Junhui Lang[1]; Jamal Moussa,[2] Abdelkrim. El-Ghayoury,[3] Galyna Myronchuk[4] and Bouchta Sahraoui[1]

[1] *Univ Angers, LPHIA, SFR MATRIX, F-49000 Angers, France*

[2] *Sorbonne Université, CNRS, Institut Parisien de Chimie Moléculaire, IPCM, F-75005 Paris, France*

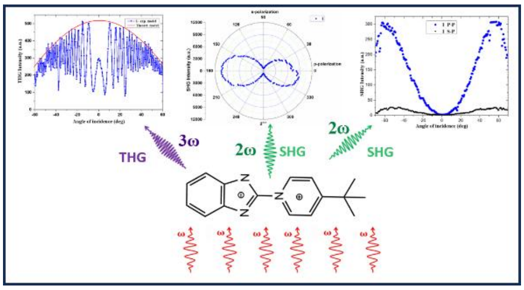
[3] *Univ Angers, CNRS, MOLTECH-ANJOU, SFR MATRIX, F-49000 Angers, France*

[4] *Lesya Ukrainka Volyn National University, 13 Voli Ave, 43025, Lutsk, Ukraine*

Abstract

The design of high-performance nonlinear optical materials is of growing importance for the development of future photonic technologies. This presentation offers a broad and forward-looking perspective on the molecular engineering of functional organic chromophores and their transition-metal complexes as promising platforms for advanced nonlinear photonics[1].

The lecture will highlight how donor–acceptor molecular frameworks, combined with metal-centered electronic flexibility, provide powerful opportunities to modulate charge transfer, polarization anisotropy, and electronic delocalization[2]. The incorporation of transition-metal centers such as Cu, Hg, and Ir introduces an additional level of control over optical behavior, leading to richer structure–property relationships and enhanced light–matter interactions. Beyond individual molecular systems, the talk will emphasize the broader concept of integrating organic and coordination-based architectures into functional photonic materials with tunable nonlinear responses. This synergistic molecular-to-complex strategy opens attractive perspectives for optical modulation, frequency conversion, ultrafast signal processing, and multifunctional photonic devices[3]. By bridging organic molecular design, coordination chemistry, and photonic materials science, this contribution provides a general vision of how hybrid molecular and metal-complex systems can contribute to the next generation of nonlinear optical materials for advanced light technologies.



Acknowledgment

The presented results are part of the TeraHertz project that has received funding from the HORIZON-MSCA-2021-SE-01 Program, agreement number 101086493.

Recent Publications

[1] S. Taboukhat, N. Kichou, J.-L. Fillaut, O. Alévêque, K. Waszkowska, A. Zawadzka, A. El-Ghayoury, A. Migalska-Zalas, B. Sahraoui, Transition metals induce control of enhanced NLO properties of functionalized organometallic complexes under laser modulations, Sci. Rep. 10 (2020) 15292. https://doi.org/10.1038/s41598-020-71769-2.

[2] S. Taboukhat, C. Wu, D. Amelot, D.T. Pham, S.S. Jamil, A. El-Ghayoury, J. Moussa, A. Kityk, B. Sahraoui, Insights into the Strong Nonlinear Optical Ability of Functionalized Pyridinium-Benzimidazole Derivatives, J. Phys. Chem. C 129 (2025) 22590–22598. https://doi.org/10.1021/acs.jpcc.5c06717.

[3] S. Taboukhat, A. Aamoum, A. Ayadi, A. Shili, A. Zawadzka, K. Waszkowska, P. Płóciennik, A. El-Ghayoury, N. Zouari, R. Wielgosz, A. Andrushchak, D. Guichaoua, A. Migalska-Zalas, B. Sahraoui, High-Order Harmonics and Photoluminescence in Azo-Phenylthiophene Derivatives, J. Phys. Chem. C 128 (2024) 19839–19848. https://doi.org/10.1021/acs.jpcc.4c05126.

Biography

Dr. Said Taboukhat obtained a PhD from the Université d'Angers (France) and Hassan II University of Casablanca (Morocco) in 2018. He is a physicist specializing in molecular engineering, materials science, nonlinear optics, and photonics, is a member of the Photonics Laboratory. His research focuses on the design and development of innovative multifunctional molecular and hybrid systems for advanced optical applications. He has particular expertise in nonlinear optical (NLO) materials, molecular photonics, and structure–property relationships governing light–matter interactions.

His work involves the modeling and characterization of organic, inorganic, and metal-complex-based systems exhibiting enhanced second- and third-order nonlinear responses. He has extensive experience in nonlinear electro-optic effects, molecular hyperpolarizabilities, and macroscopic susceptibilities, with applications in frequency conversion, optical modulation, and ultrafast photonic technologies. Dr. Taboukhat's research bridges fundamental molecular physics and applied materials science, contributing to next-generation photonic and optoelectronic materials with tunable nonlinear optical functionalities.

Email: said.taboukhat@univ-angers.fr