GOOD VIBES: PHOTO-ACTIVATION AND FUNCTIONALIZATION OF INERT C-H BONDS AT THE VIBRATIONAL LEVEL

LABORATORY : Institut Lumiere Matiere
IN COOPERATION WITH : ILM-ICBMS
LEVEL : M1
TEAM(S) : DYNAMO

CONTACT(S) : COMPAGNON Isabelle

CONTACT(S) DETAILS: isabelle.compagnon@univ-lyon1.fr / Tel. 0472448368

KEYWORD(S) : green chemistry / homogeneous catalysis / IR spectroscopy

SCIENTIFIC CONTEXT :

The major concern in chemical synthesis is the creation of new compounds with very rich chemical diversity and highly adaptable properties, starting from readily available and simple row materials, in an efficient and sustainable manner. In this regard, the development of homogenous transition metal catalysts that promote highly selective, otherwise impossible reactions, has revolutionized chemical industry and has considerably changed the quality, economics, and energy consumption of our modern societies. The power of transition metal catalysts stands on their ability to convert inert bonds, such as C-H bonds, into a more reactive organometallic species. In spite of the significant progress achieved, classical activation methodologies with transition metal catalysts are facing inextricable challenges: (i) the activation of very strong bonds of readily available row materials (biomass, natural gases) requires very high (thermal) energy, with harsh reaction conditions, (ii) another unsolved challenge concerns the selectivity, i.e, how to selectively activate a strong C-H bond in densely functionalized organic compounds?

MISSIONS :

In this project, we propose to explore a completely new strategy that is based on the use of tunable infrared lasers in combination with transition metal catalysts to selectively activate and functionalize inert and robust bonds under mild conditions. IR tunable Lasers provide a highly monochromatic and dense energy flux light source allowing selective vibrational excitation of the desired chemical group, and thus selective cleavage, of the right chemical bond in molecules. This is an interdisciplinary project bringing together collaborators from the fields of organometallic chemistry and molecular physics. The major objective of this pioneering project will be to investigate the use of molecular IR-lasers emitting wavelengths just coinciding with the vibrational frequency of a specific C-H bond of aromatic substrate, in such a way that only this bond is selectively excited at the right vibrational state, thus climbing the activation barrier on the reaction coordinate, allowing the selective insertion of the transition metal under mild conditions. We will study the impact of IR excitation on model organometallic transformations.

OUTLOOKS :

BIBLIOGRAPHY :

References related to the project: a) T. Stensitzki, K. Heyne & al. Nature Chem., 2018, 10, 126; b) R. Zare, Science 1998, 279, 1875.

published on 18 septembre 2020