



H.F.R.I.
Hellenic Foundation for
Research & Innovation

Description of the funded research project
1st Call for H.F.R.I. Research Projects to Support Faculty Members &
Researchers and Procure High-Value Research Equipment

Title of the research project: Advancing the Sustainable Nature of Catalysis: New Synthetic Methodologies and Valuable Organic Architectures



Principal Investigator: Georgios C. Vougioukalakis, Associate Professor in Organic Chemistry

Reader-friendly title: SUSTAIN

Scientific Area: Natural Sciences

Institution and Country: National and Kapodistrian University of Athens - Greece

Host Institution: National and Kapodistrian University of Athens

Collaborating Institution(s): Ghent University (Belgium), Girona University (Spain), Stuttgart University (Germany)

Project webpage: <http://users.uoa.gr/~vougiouk/sustain/>



Budget: 199,691.03 Euros

Duration: 36 months

Research Project Synopsis

Transition metal catalysis has revolutionized the way chemists design and synthesize novel or existing molecules. This has been recently translated into three Nobel Prizes, awarded in 2001, 2005, and 2010. Catalysis is a sustainable process by its nature, as it reduces energy consumption and waste generation. Unfortunately though, most of the transition metal catalysts employed today rely on the use of rare, expensive and often highly-toxic transition metals or the need for stoichiometric oxidants. Sustainable catalysis, an emerging and vibrant concept in Chemistry, offers reliable solutions to these problems by amongst others employing catalysts based on nontoxic or biocompatible and/or abundant, inexpensive metal sources.

SUSTAIN will introduce and implement a full set of valuable synthetic chemistry strategies and tools, based on the principles of sustainable chemistry and development. Among others, the project envisages the establishment of groundbreaking highly-efficient technologies of multicomponent, domino, or C-H activation transformations, in some cases done enantioselectively or by utilizing CO₂ as chemical feedstock, along with their application in the synthesis of compounds with important biological and technological applications. These transformations are step- and atom-economical, thus inherently green. Moreover, they will result in several breakthroughs, by employing, for the first time in these reactions, sustainable metals such as Cu, Zn, and Mn, or even organocatalysis. SUSTAIN will also develop innovative, highly-efficient Au catalytic systems in underexplored, oxidant-free (and, therefore, significantly more economic and environmentally-benign) cross-coupling reactions, as well as electrocatalytic transformations employing novel, non-noble Co- and Ni-based catalysts. More groundbreaking advancements in the field are anticipated through the targeted Fe- or Mn-catalyzed C_{sp}³-H bond activation tools, or the utilization of new, remote or traceless directing groups for sustainable catalysis in C_{sp}²-H bond activation.

Project originality

A number of innovative, sustainable catalytic systems and new synthetic approaches will be developed and used in the preparation of compounds with important biological and technological applications.

Expected results & Research Project Impact

The results of SUSTAIN are anticipated to be of fundamental importance to the field, contributing significantly to the development of innovative, sustainable catalytic procedures and systems with enhanced stability, selectivity, activity, and reaction scope, thereby moving a step closer to their practical, large-scale applications. SUSTAIN will significantly benefit the communities of organic chemistry, catalysis, coordination and organometallic chemistry, as well as that of materials and polymers synthesis and the synthesis of compounds with biological interest and applications. Moreover, it will markedly contribute to the Greek research ecosystem's and European Research Area's excellence and competitiveness. SUSTAIN can also have a significant impact for both the Greek and the EU economy. From a societal point of view, this project is in agreement with the requirements of the European chemicals' laws, adheres to the principles of circular economy, and will have a significant impact on the Greek and European response to a society of sustainable development.

The importance of this funding

Funding of SUSTAIN is extremely important for our research group and will give us the opportunity to implement top-notch research, in a field of fundamental importance for the sustainable development of our society.



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