Benign-by-design strategies for biomass/waste conversion into valuables: present and future

Prof. Rafael Luque

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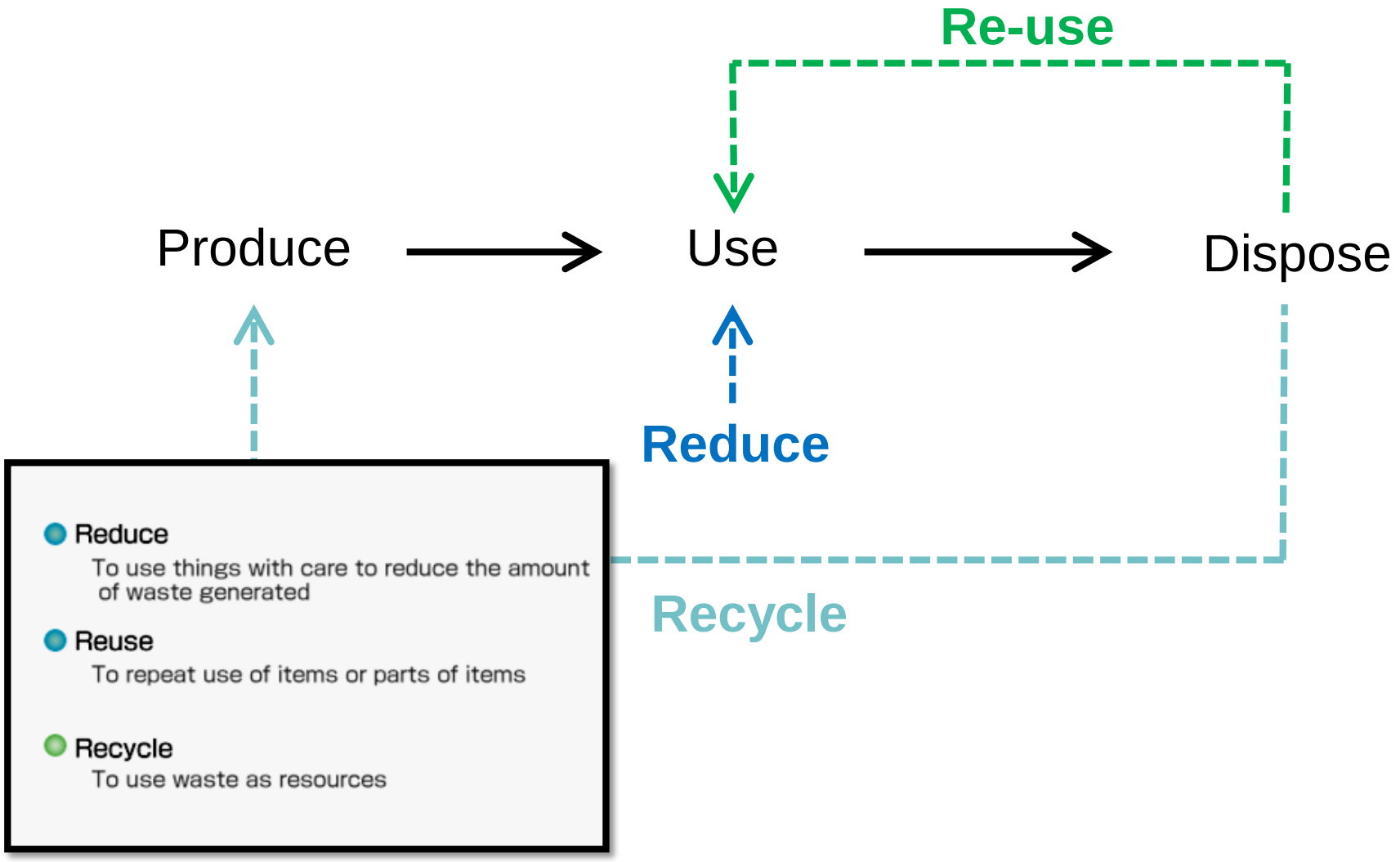
DEPARTAMENTO DE QUÍMICA ORGÁNICA,
UNIVERSIDAD DE CÓRDOBA

What do these images tell you?

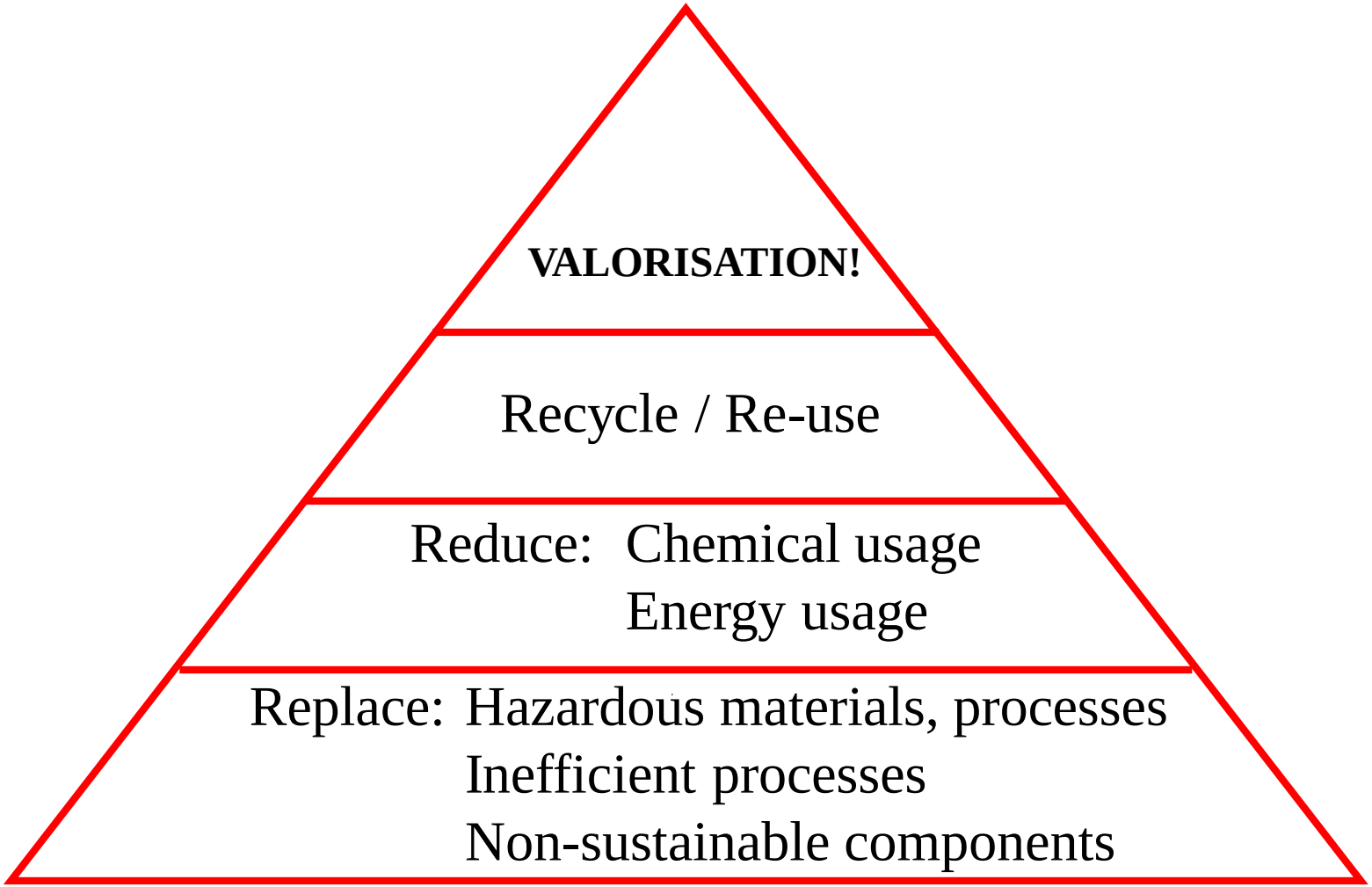
ITS ALWAYS THE SAME THING……

Produce → Use → Dispose

Mindset change: The circular economy…



… and way beyond!



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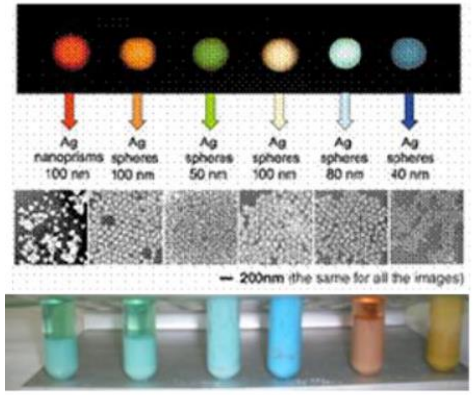
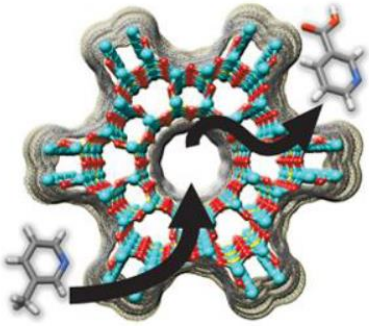
RESEARCH TOPICS

Nanoscale Chemistry



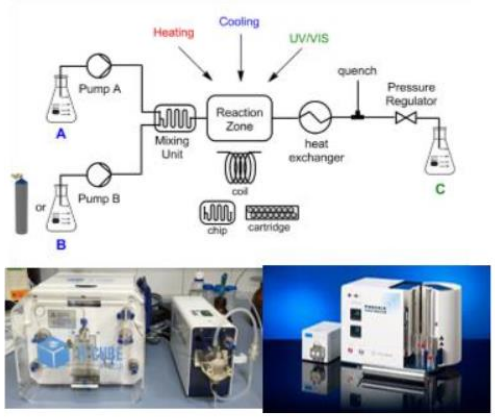
Project leader:
Noelia Lazaro

Heterogeneous (Photo)(bio)Catalysis



Project leader:
Thomas Len

Flow Chemistry



Project leader:
Antonio Pineda

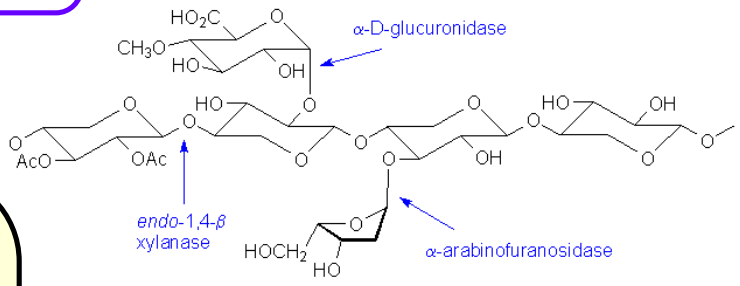
Biomass and Waste Valorization

Project leader:
Ashish Bohre

These include *novel protocols for materials engineering*, *flow chemical processes*, and *biomass & waste valorization*.

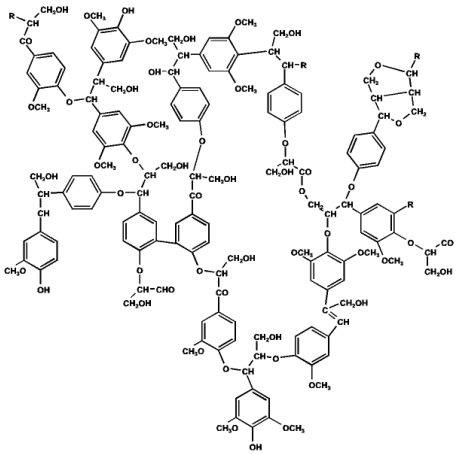
Knowing chemical composition is the key to success!!!

HEMICELLULOSE

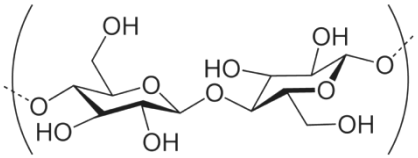


Lignocellulosics

LIGNIN



CELLULOSE



MINOR CONSTITUENTS

http://www.uco.es/~q62alsor

WASTE TO WEALTH: FROM RESIDUES TO MARKETABLE PRODUCTS




NANOCATALYSIS!!

Green technologies

(e.g. microwaves, extraction, fractionation)

Personal care products

Coatings and unguents

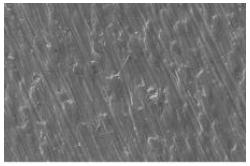
Paint additives

Biodegradable plastics


Other derivatives (chemicals, fuels, etc.)

Two representative examples

- **Waste to biomaterials and energy**



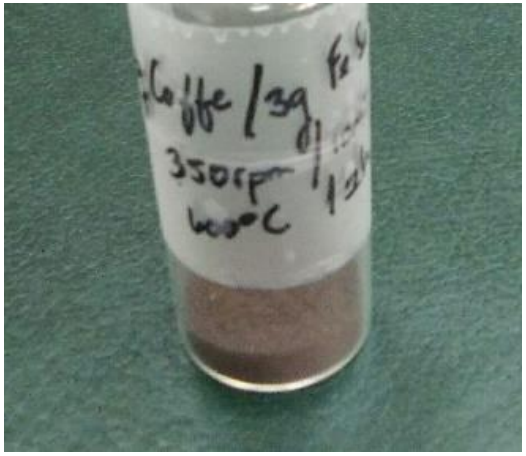
- Waste-to-pharma

http://www.uco.es/~q62alsor/

FOOD WASTE VALORISATION

Metal precursors

Coffee waste grounds



Magnetic nanomaterials

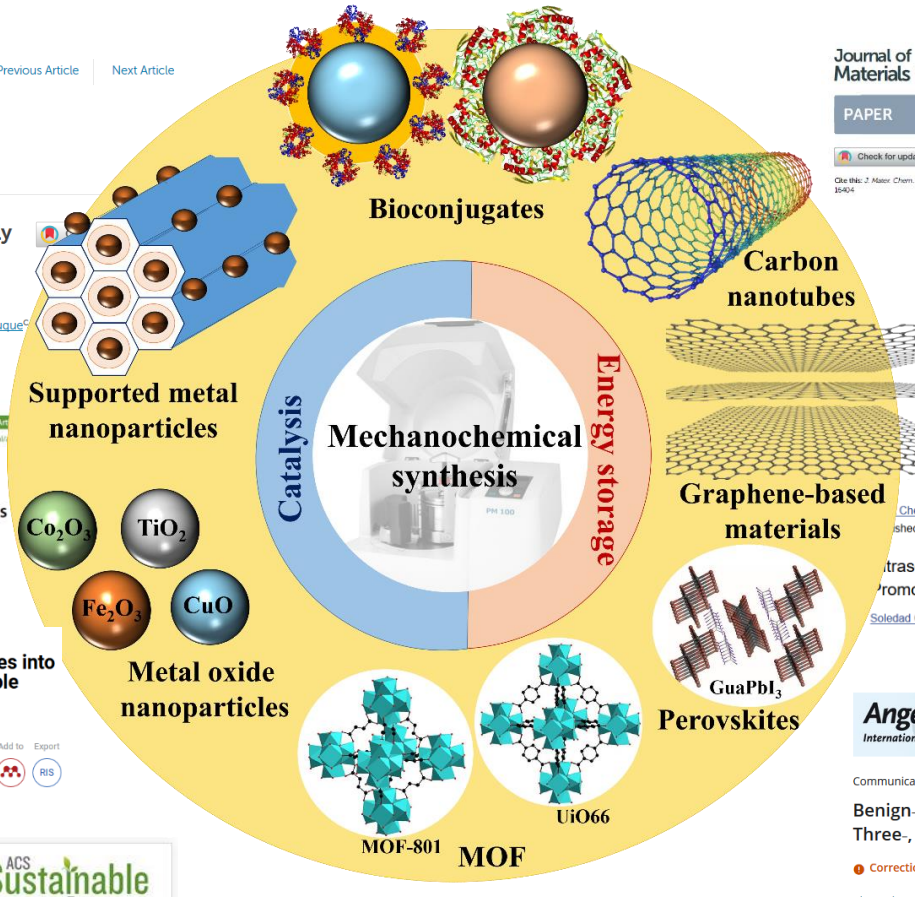
Mecanochemistry for nanomaterials design

Issue 4, 2015 Previous Article Next Article

From the journal: Catalysis Science & Technology

Mechanochemical preparation of advanced catalytically active bifunctional Pd-containing nanomaterials for aqueous phase hydrogenation

Majd Al-Naji,[a] Alina M. Balu,*[ab] Anca Roibu,[a] Michael Goepel,[a] Wolf-Dietrich Einicke,[a] Rafael Luque[c]



ACS Sustainable Chemistry & Engineering

Benign-by-Design Orange Peel-Templated Nanocatalysts for Continuous Flow Conversion of Levulinic Acid to N-Heterocycles

Daily Rodríguez-Padrón,[†] Alain R. Puente-Santiago,[†] Alina M. Balu,[†] Antonio A. Romero,[†] Mario J. Muñoz-Batista,[*,†] and Rafael Luque[*,†,‡]

RETURN TO ISSUE < PREV ARTICLE NEXT >

Post-synthetic Mechanochemical Incorporation of Al-Species into the Framework of Porous Materials: Toward More Sustainable Redox Chemistries

M. Dolores Marquez-Medina, Sareena Mhadmhan, Alina M. Balu, Antonio A. Romero and Rafael Luque*

Cite This: *ACS Sustainable Chem. Eng.* 2019, 7, 10, 9537-9543

Publication Date: April 22, 2019

https://doi.org/10.1021/acssuschemeng.9b00912

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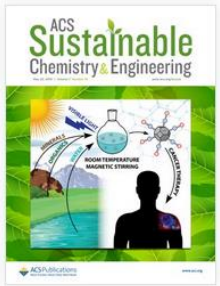


ACS Sustainable

ACS Sustainable Chemistry & Engineering

Feature

Mechanochemistry: Toward Sustainable Design of Advanced Nanomaterials for Electrochemical Energy Storage and Catalytic Applications

Mario J. Muñoz-Batista,[†] Daily Rodriguez-Padron,[†] Alain R. Puente-Santiago,[†] and Rafael Luque[*,†,‡]

Journal of Materials Chemistry A

PAPER View Article Online

Mechanochemical design of hemoglobin-functionalised magnetic nanomaterials for energy storage devices†

Daily Rodríguez-Padrón, Alain R. Puente-Santiago, Alvaro Caballero, Almudena Benitez, Alina M. Balu, Antonio A. Romero and Rafael Luque

frontiers in Chemistry

Chem. 2018; 6: 197.

shed online 2018 Jun 7. doi: 10.3389/fchem.2018.00197

PMCID: PMC

PMID:

trasound-Assisted Esterification of Valeric Acid to Alkyl Valerates Promoted by Biosilicified Lipases

Soledad Cebrián-García,[1] Alina M. Balu,[1] and Rafael Luque[1,2,*]

Angewandte International Edition Chemie

GDCh A Journal of the German Chemical Society

Communication | Full Access

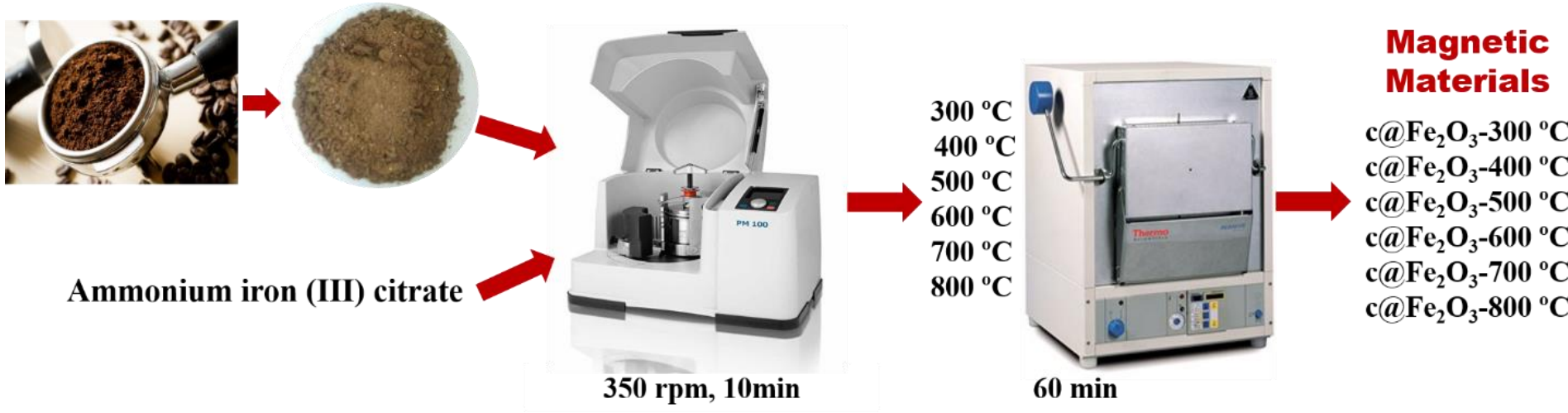
Benign-by-Design Solventless Mechanochemical Synthesis of Three-, Two-, and One-Dimensional Hybrid Perovskites

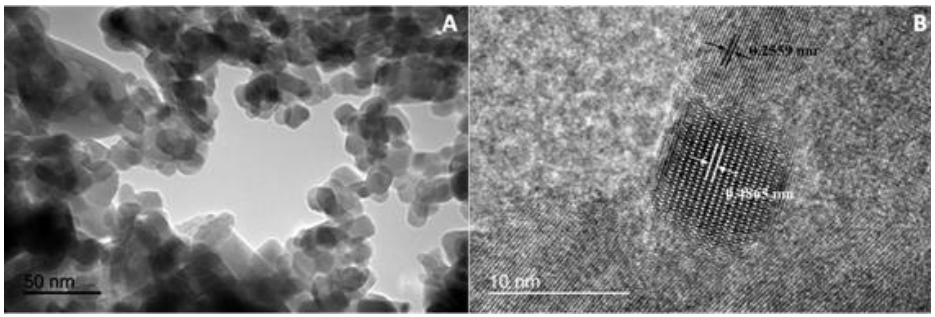
Correction(s) for this article

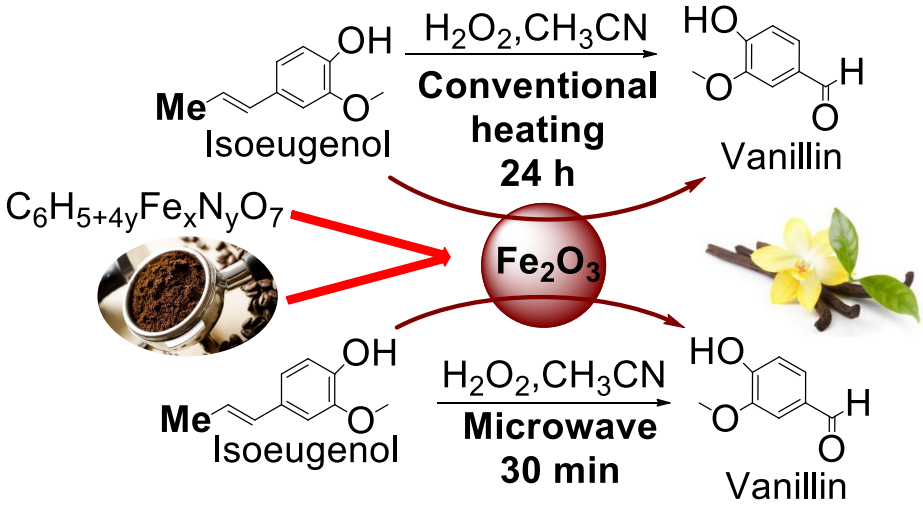
Alexander D. Jodlowski, Dr. Alfonso Yépez, Prof. Rafael Luque, Prof. Luis Camacho, Prof. Gustavo de Miguel

First published: 28 October 2016 | https://doi.org/10.1002/anie.201607397 | Cited by: 21

NANO VAL

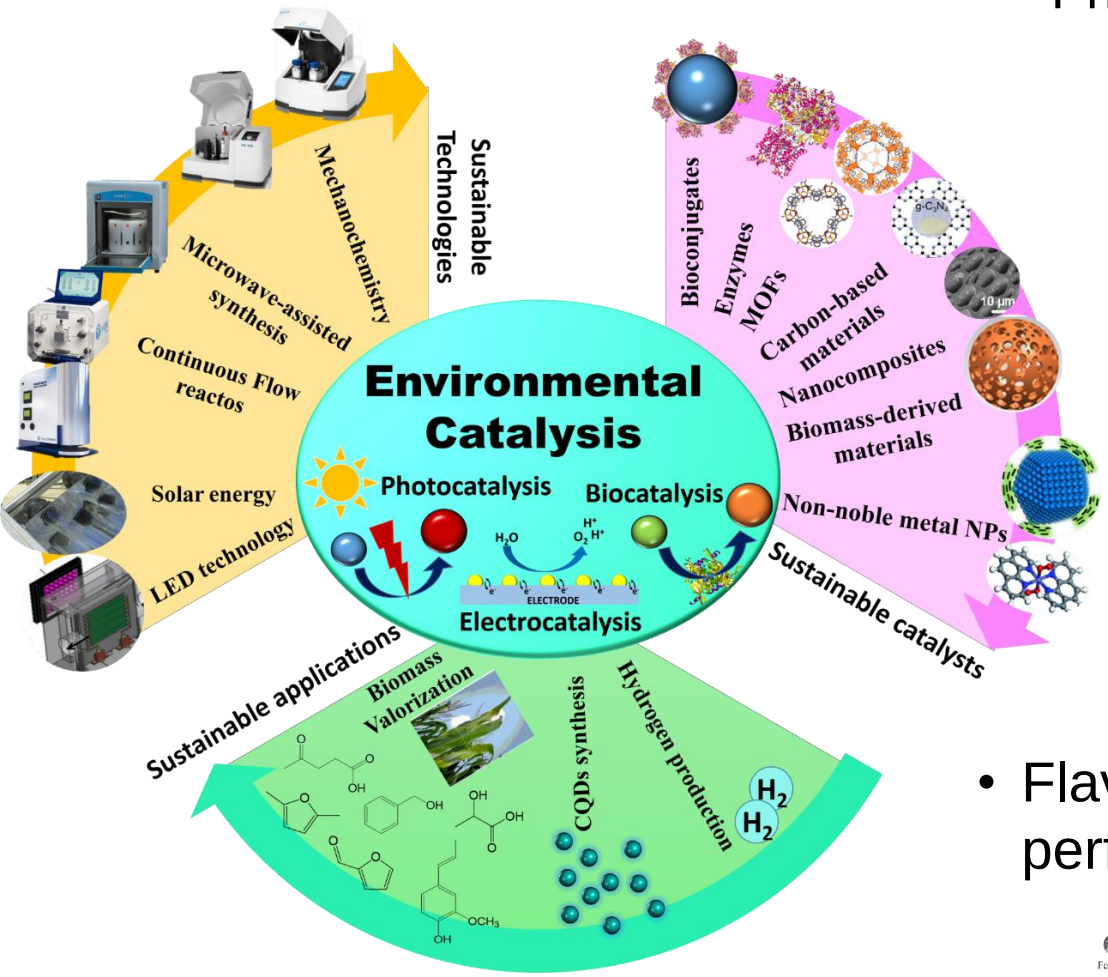




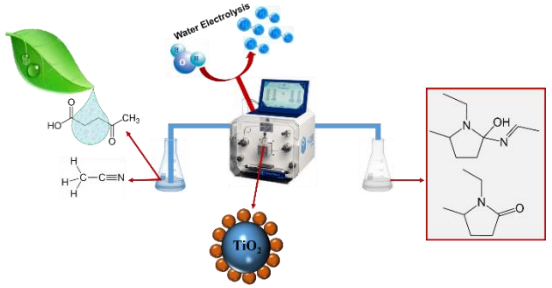


ACS Sustainable Chemistry & Engineering 2019
10.1021/acssuschemeng.9b02919

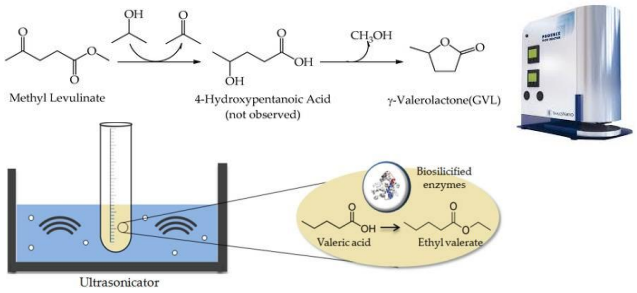
Applications-CATALYSIS



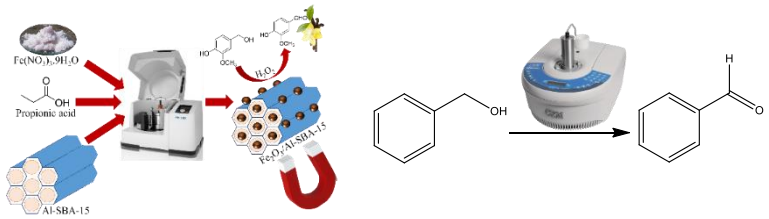
- Pharmacophores and agrochemicals



- Biofuels and fuels aditives.

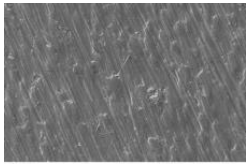


- Flavoring molecules for cosmetics, perfumes and food industries.



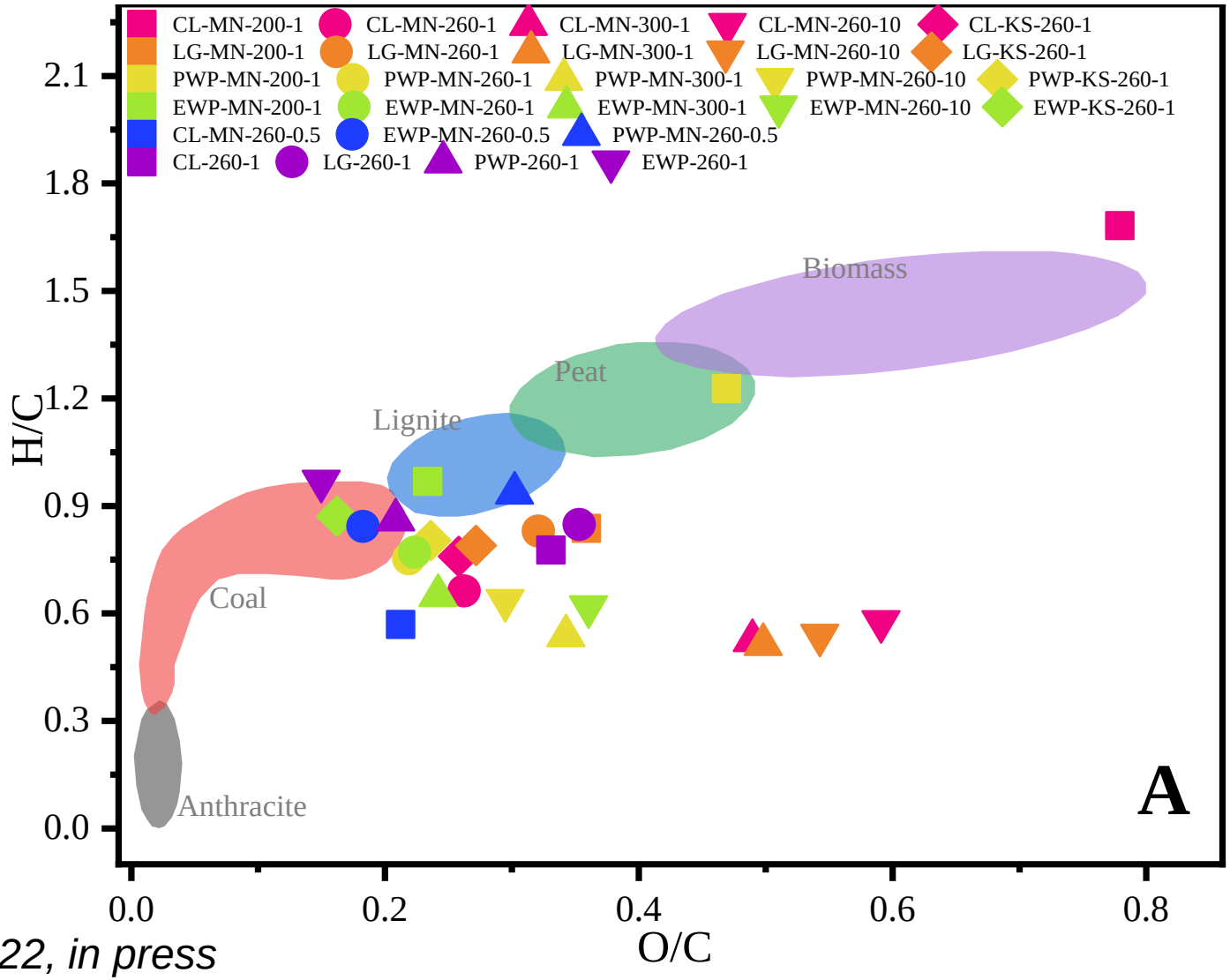
Two representative examples

- **Waste to biomaterials and energy**



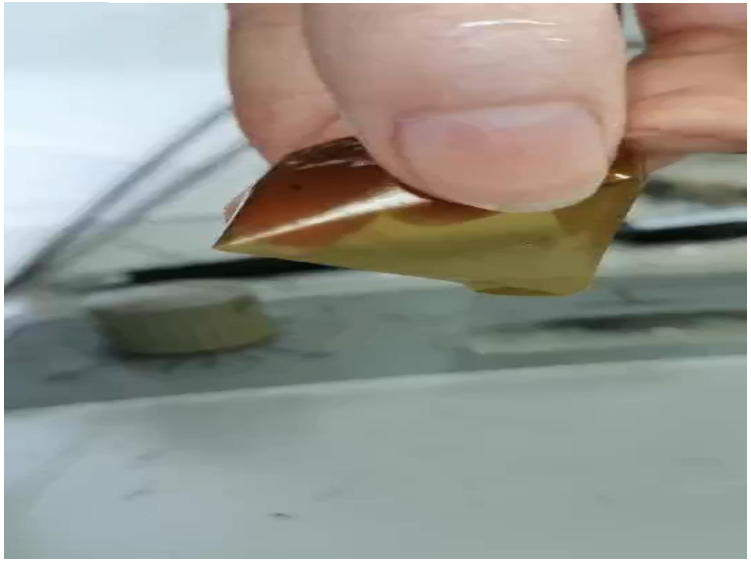
- Waste-to-pharma

Waste to artificial coal



ACS SustChem Eng 2022, in press

Waste to bioplastics

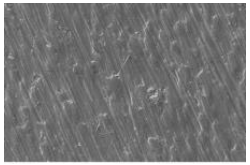


Science 2022, submitted; Chinese Patent 2021

Weighing Raw Material
3g of Citric Acid and 6ml of Deior
3g of Protein Based Solid Product and 16m

Two representative examples

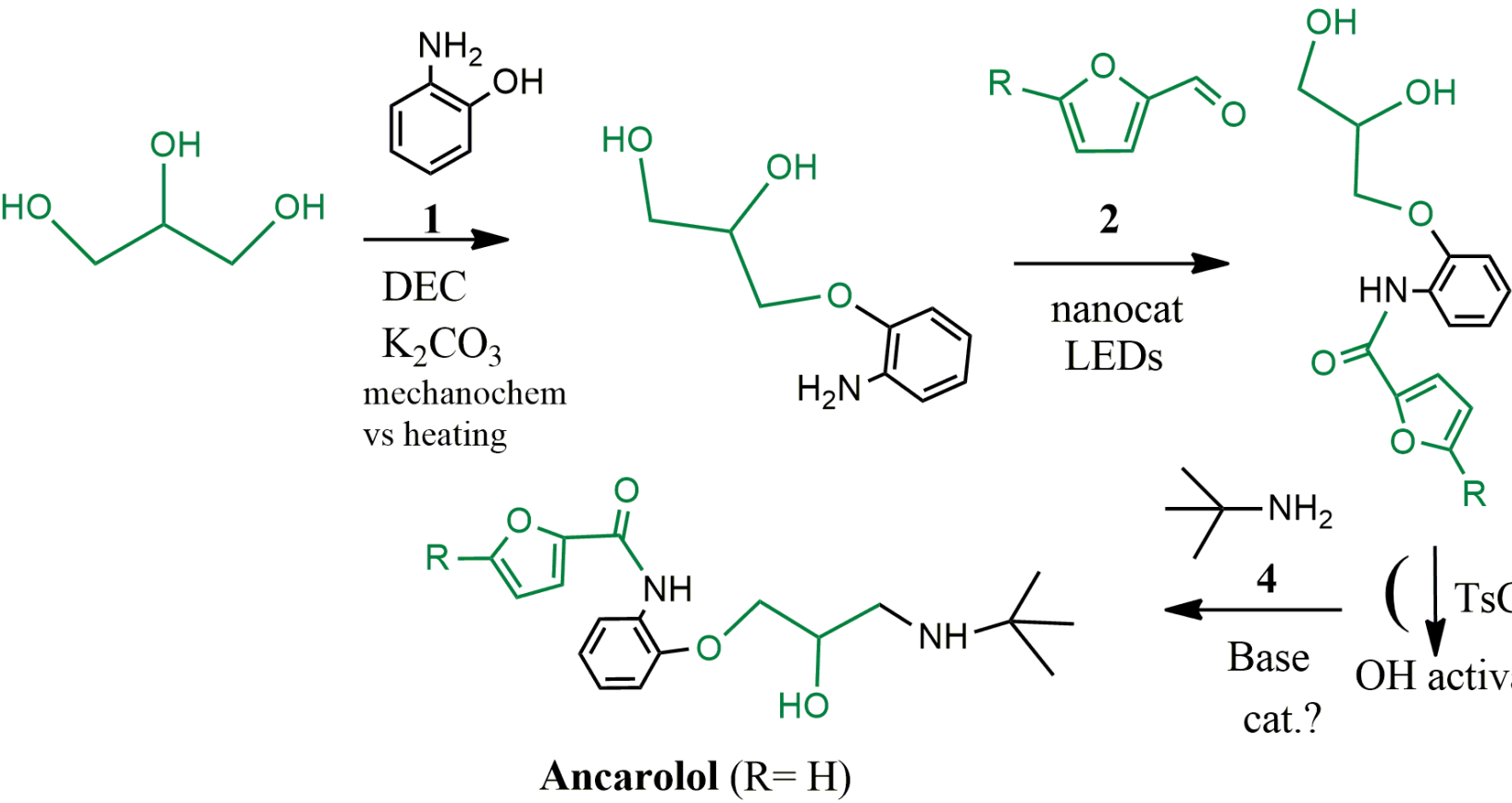
- Waste to biomaterials and energy



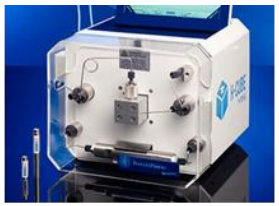
- **Waste-to-pharma**

Sustainability

Ecotoxicology



Ancarolol (R= H)

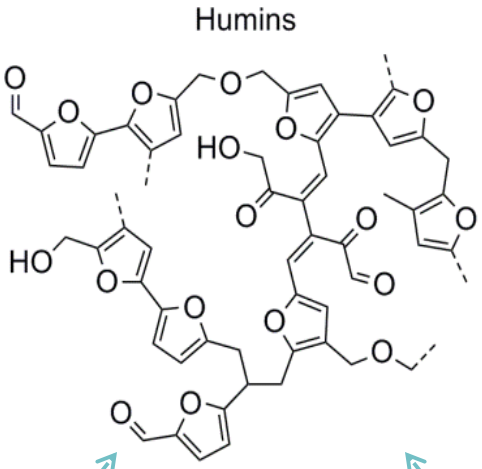


Flow chemistry

Nanomaterials (Mechano-chemistry)

ACS SustChem Eng 2022, submitted

Humin by-products



Structure proposed by
I. van Zandvoort *et al.*
(2013) ChemSusChem 6: 1745-1758.

polymerization

desired product

side-reaction

Heat

nH_2O

Hexoses

H^+

$3H_2O$

HMF

H^+

$2H_2O$

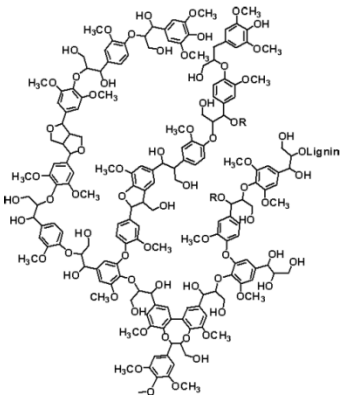
Levulinic Acid

+

Penloses

+

Formic Acid

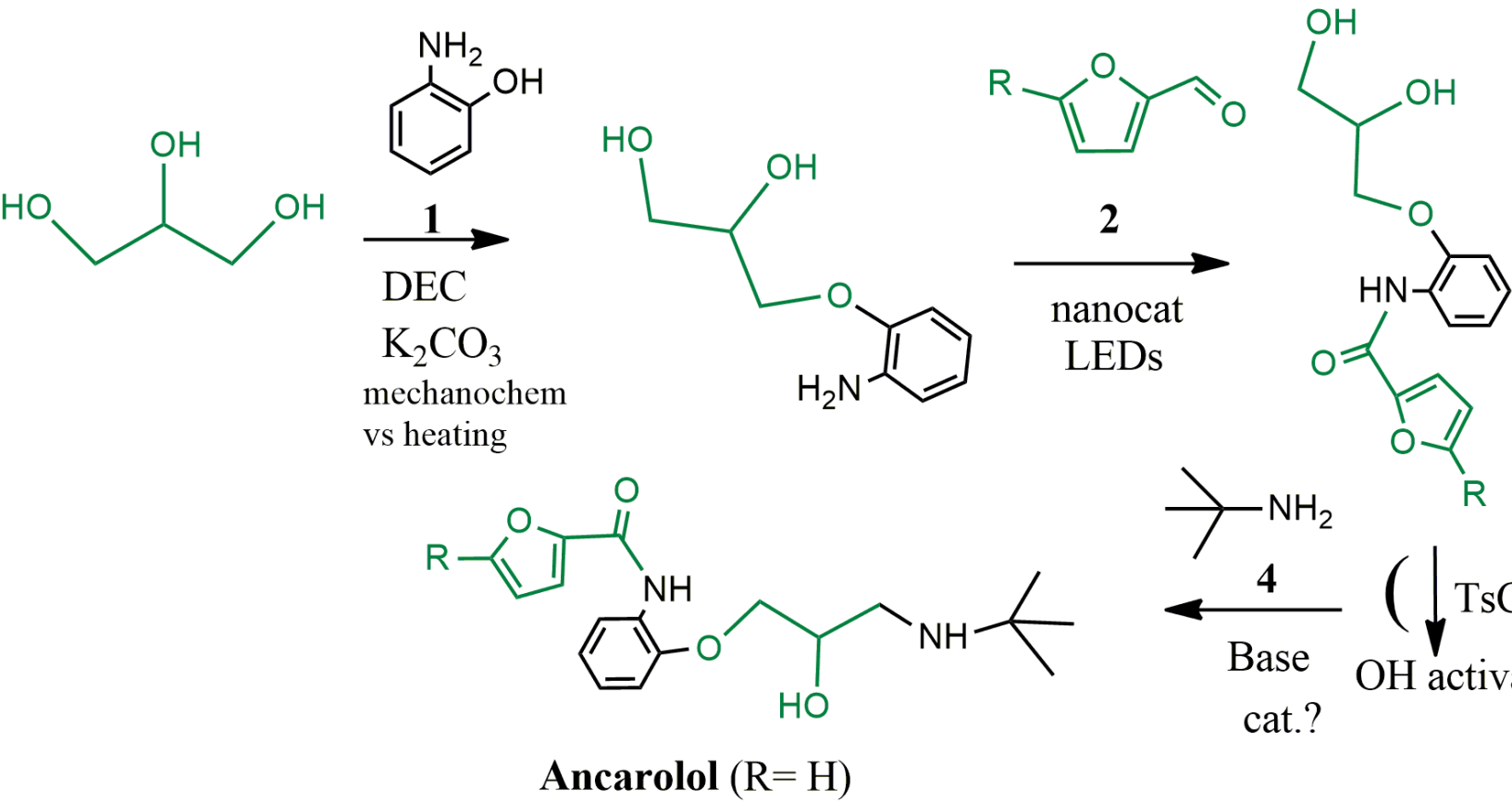


Lignin

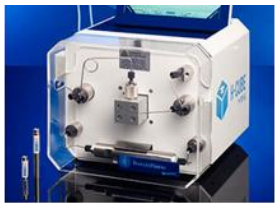
Humins are random polydisperse macromolecules with a **furanic backbone** and **oxygenated linkages**(e.g. alcohol, aldehyde, acetals, ketone)

Sustainability

Ecotoxicology



Ancarolol (R= H)



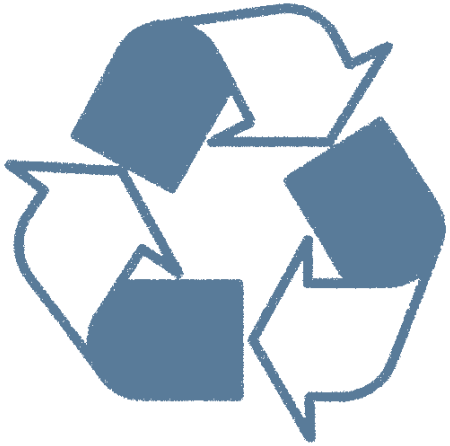
Flow chemistry

Nanomaterials (Mechano-chemistry)

ACS SustChem Eng 2022, submitted

Chem Soc Rev 2021, in press
ACS Sust. Chem. Eng 2022, under review
Green Chemistry 2022, under review

Outlook and future prospects



Continuous Flow

Time to say thanks…. And more

rafael.luque@uco.es

Molecular Catalysis

IF (2020) = 5.06

Formerly known as:

Journal of Molecular Catalysis A: Chemical

40 years proud history;

Welcome catalysis research from **homogeneous**, **heterogeneous** and **biocatalysis** areas!

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