Jornada sobre ECONOMÍA CIRCULAR de los IUIs de la Universidad de Zaragoza

Viernes, 26 de noviembre, 2021.

Facultad de Economía y Empresa. Gran Vía, 2. Salón de Actos.

Meet https://meet.google.com/fmr-eogr-yim

Departamento de Ingeniería Química y Tecnologías del Medio Ambiente
Universidad Zaragoza

INMA
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

Materiales catalíticos derivados de biomasa para la producción renovable de hidrógeno y vectores energéticos

Prof. Antonio Monzón
Departamento de Ingeniería química
y Tecnologías del Medio Ambiente
Instituto de Nanociencia y Materiales de Aragón (INMA)
CSIC-Universidad de Zaragoza
Email: amonzon@unizar.es

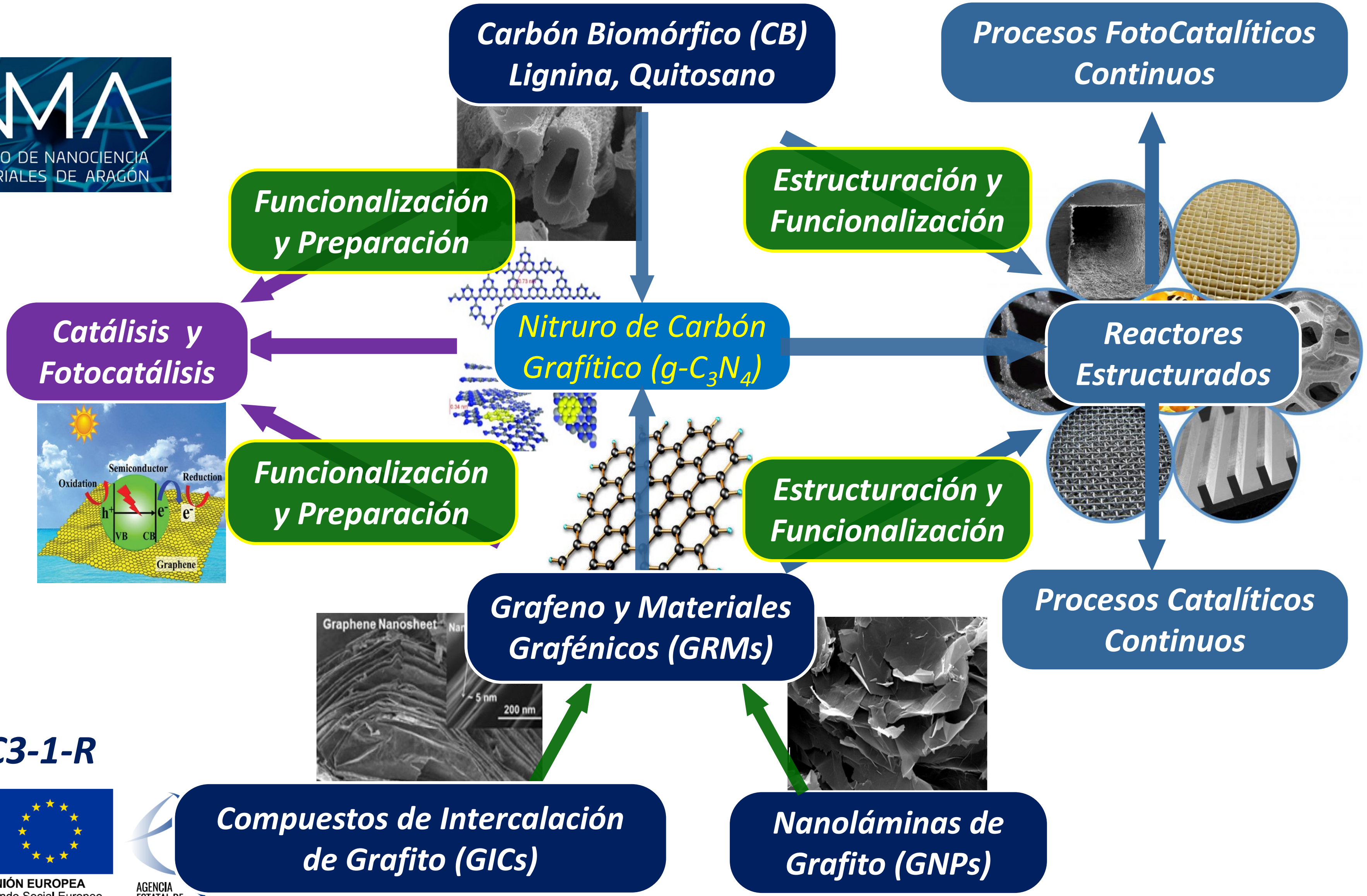
Hydrogen "Colours"

		Hydrogen Colours code	Technology	Feedstock	GHG footprint
Low Carbon Hydrogen	Production via Electricity	Green H_2	Electrolysis	Wind, Solar, Hydro, Geothermal, Tidal	Minimal
		Purple/Pink H_2		Nuclear	
		Yellow H_2		Mixed origin grid energy	Low/Medium/High
	Production via Fossil Fuels	Blue H_2	Gas reforming + CCUS Gasification + CCUS	Natural gas, Virgin Naphtha, Coal	Low
		Turquoise H_2	Pyrolysis	Natural gas/Virgin Naphtha	Solid Carbon by-product
High Carbon Hydrogen		Grey H_2	Gas reforming		Medium/High
		Brown H_2	Gasification	Brown coal (lignite)	
		Black H_2		Black coal	

Hydrogen is a colourless gas, nevertheless in the present days the energy industry has assigned a different «colour code» to differentiate among the types of hydrogen production

Use of Biomass and Sustainable Energy Production through (Photo) Structured Catalysts and Reactors Based on Carbon Materials (ENERCARB)

INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN



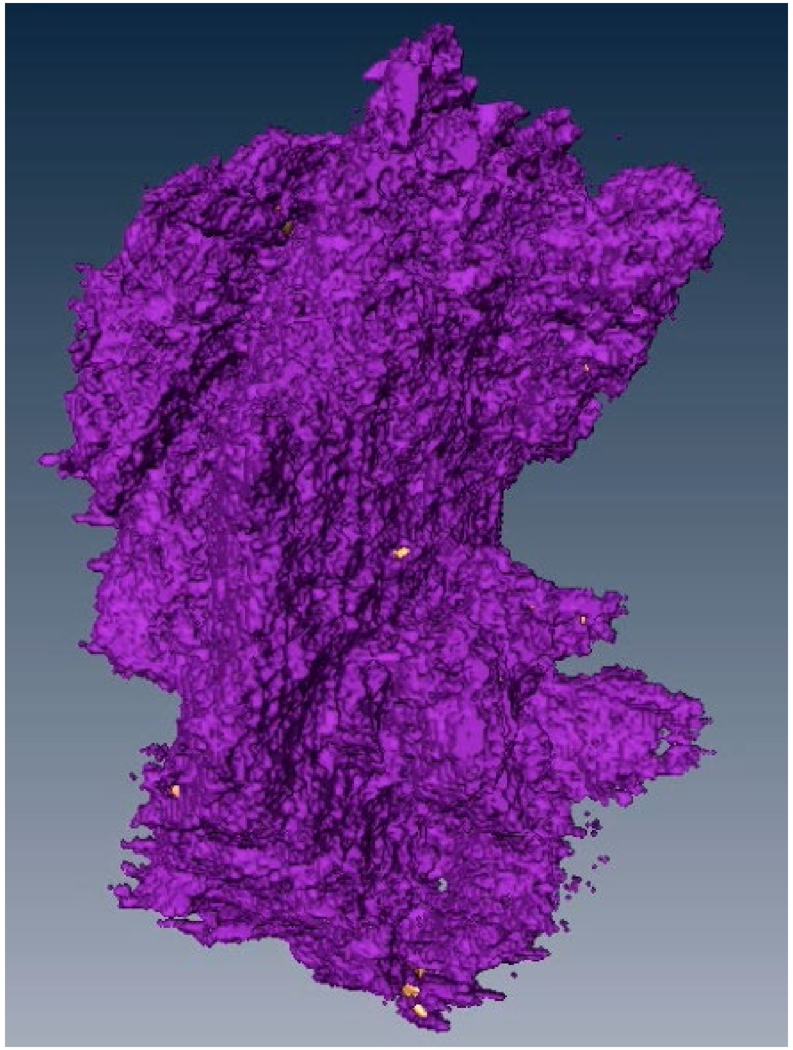
ENE2017-82451-C3-1-R

MINISTERIO DE CIENCIA E INNOVACIÓN

UNIÓN EUROPEA
Fondo Social Europeo
El FSE invierte en tu futuro

AGENCIA ESTATAL DE INVESTIGACIÓN

Use of Biomass and Sustainable Energy Production through (Photo) Structured Catalysts and Reactors Based on Carbon Materials (ENERCARB)



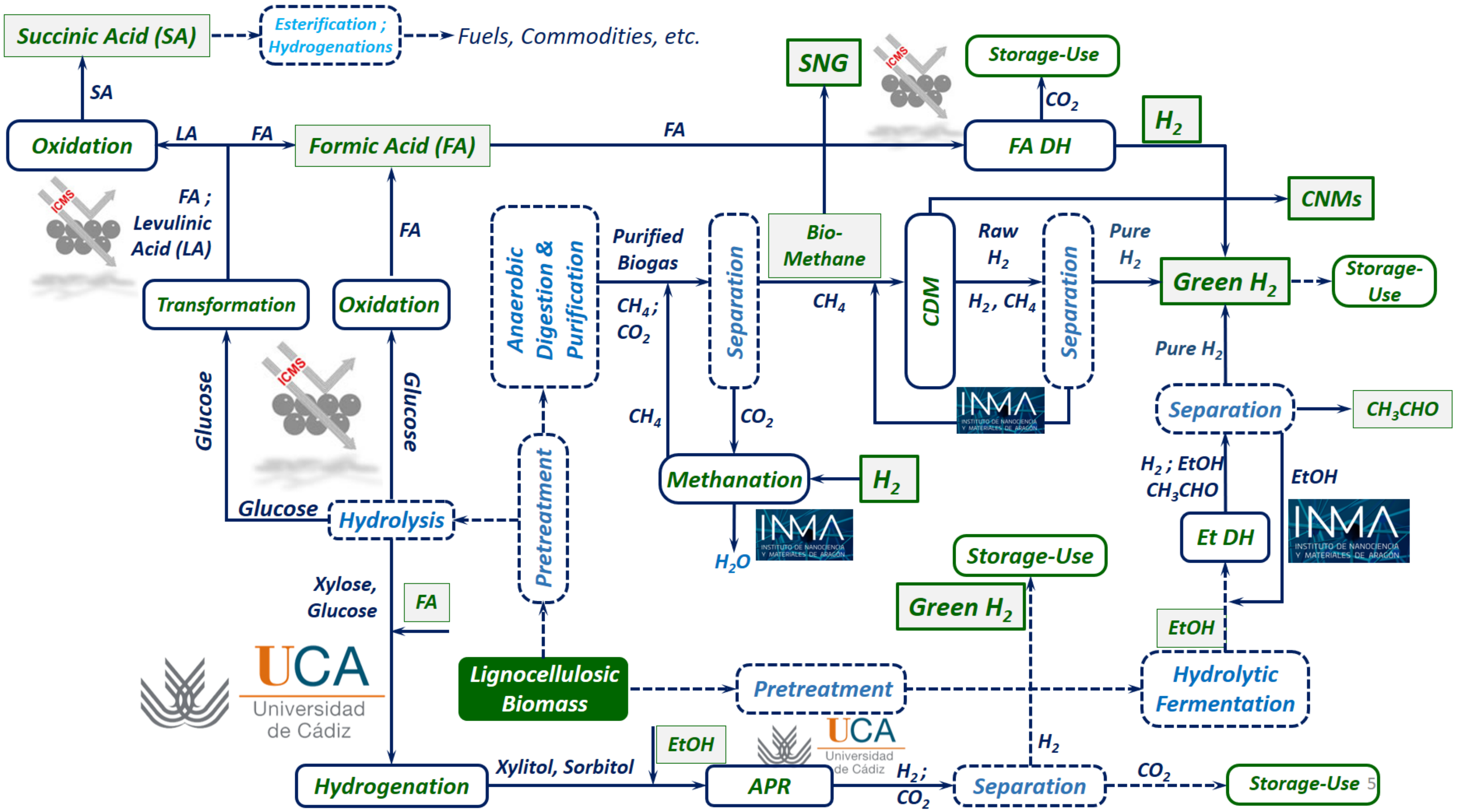
Cyclohexene Hidrogenation. Pd(6%)-Al(7%)/CDC (600 ºC)

Use of Biomass and Sustainable Energy Production through (Photo) Structured Catalysts and Reactors Based on Carbon Materials (ENERCARB)

INMA
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

Cyclohexene Hidrogenation. Pd(6%)-Al(7%)/CDC (800 ºC)

Catalytic Production and Use of Green Hydrogen and Energy Vectors Derived from Biomass (ENERCATH2)



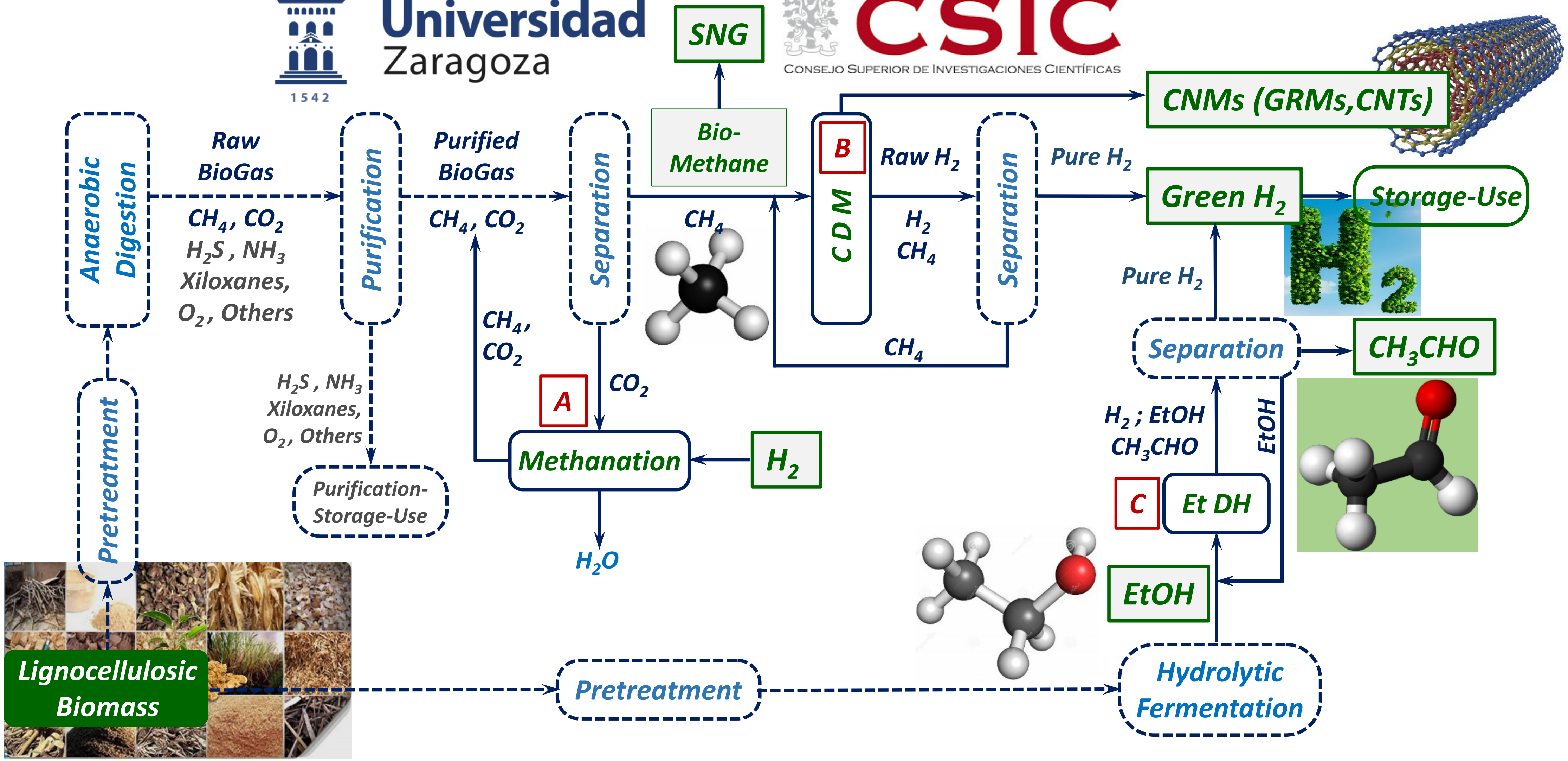
Catalytic Production and Use of Green Hydrogen and Energy Vectors Derived from Biomass (ENERCATH2)

Objectives

- ✓ *To optimize the production and use of "Green Hydrogen" and Energy Related Vectors obtained from renewable resources using catalytic routes.*
- ✓ *To develop novel catalysts based on Biomass Derived Carbons (BDC) to be applied in gas and liquid phase reactions of interest in the "Biorefinery".*

Universidad Zaragoza 1542 | INMA Instituto de Nanociencia y Materiales de Aragón | Universidad de Sevilla | ICMS | UCA Universidad de Cádiz

Biomass Derived Carbon Based Catalysts for the Production and Use of Green Hydrogen



Biomass Derived Carbon Based Catalysts for the Production and Use of Green Hydrogen

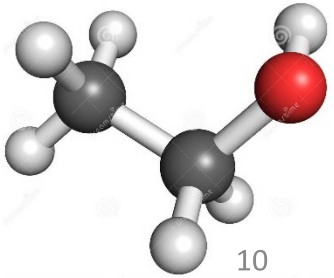
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

Objectives

- To study catalytic transformation of biogas and bioethanol into green H_2, biomethane, Carbonaceous Nanomaterials (CNMs) and acetaldehyde as very valuable coproducts of the integrated process.

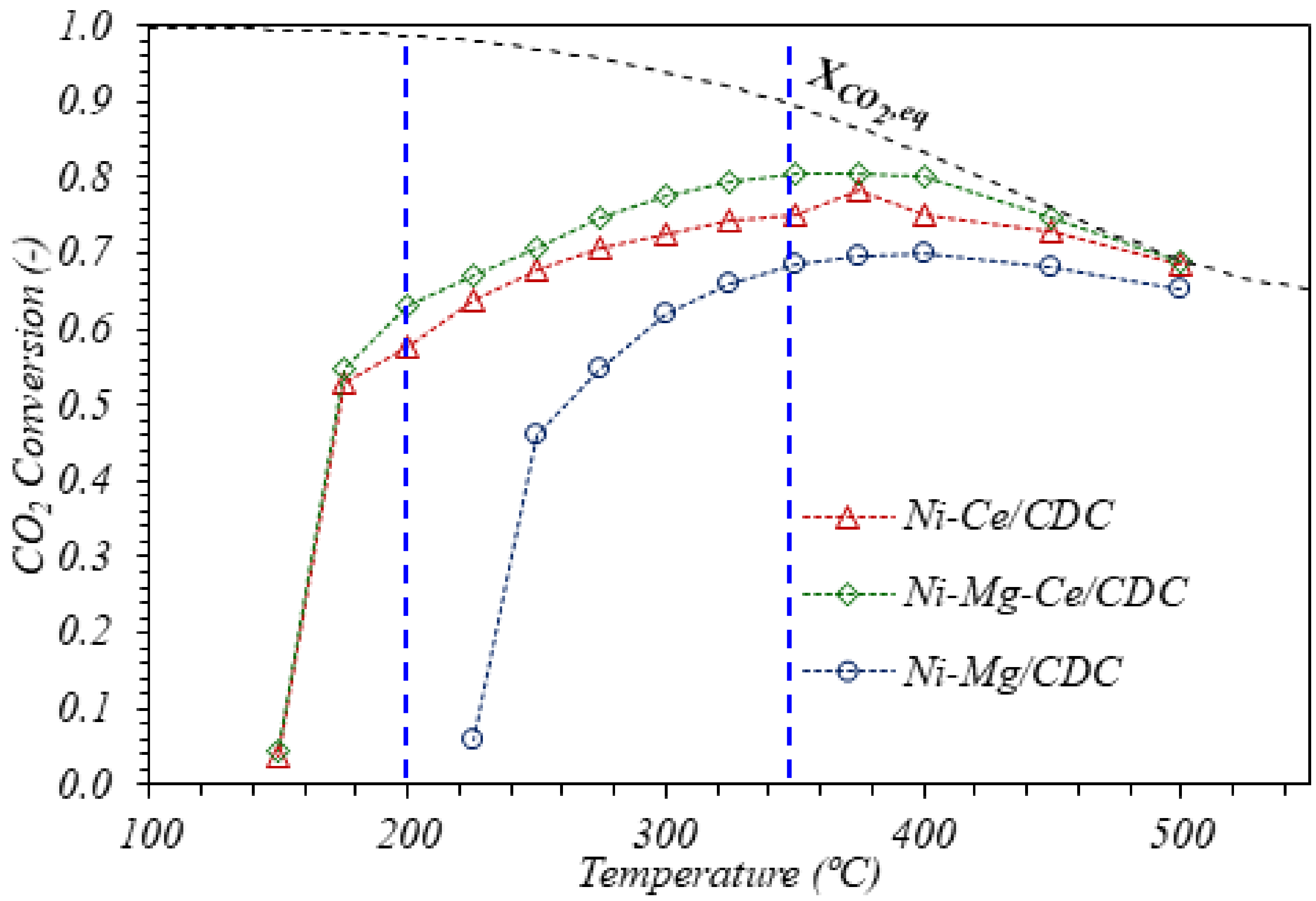
- Use of non-noble metal-based catalyst supported on Biomass Derived To develop metal-based catalysts and carbonaceous supports, using several selected biomass (biopolymers) as carbon source;

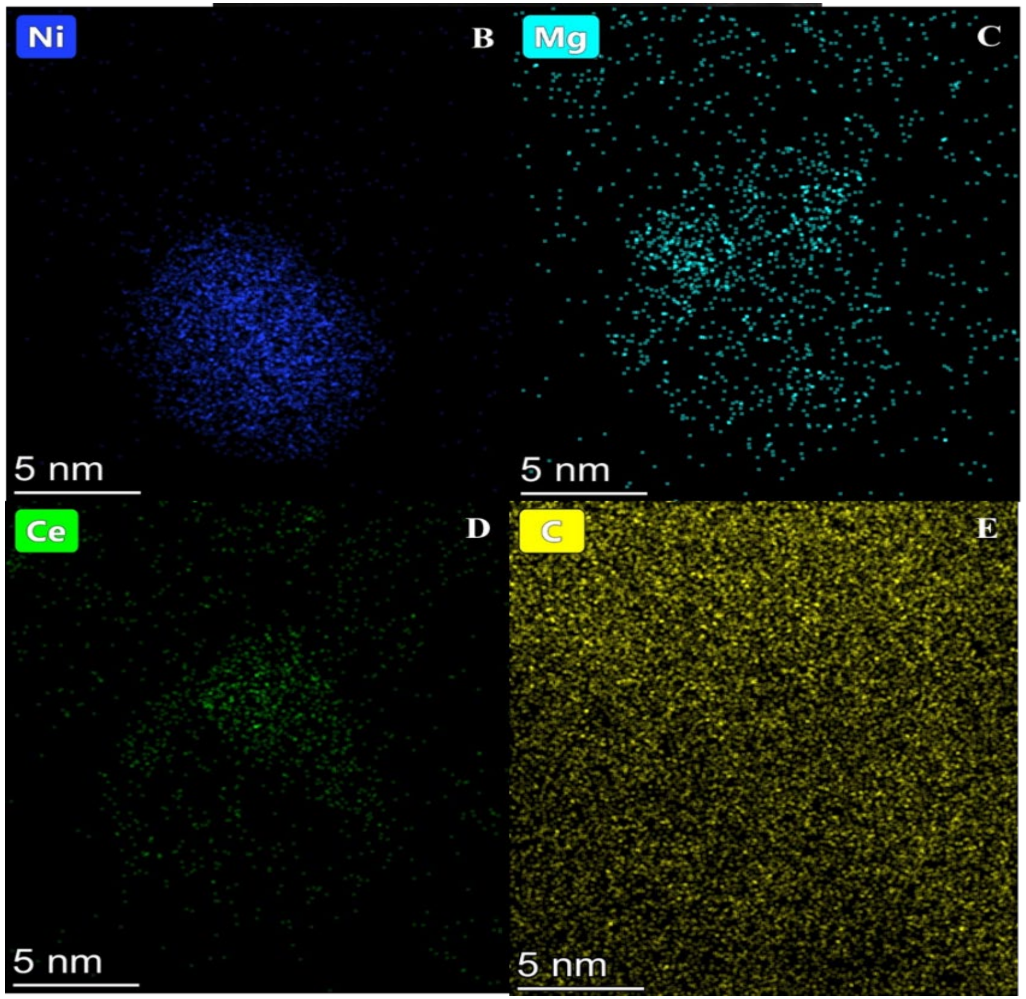
  - Production of H_2 and CNTs from biogas (CH_4+CO_2)
  - CO_2 methanation at low-T (< 200ºC)
  - Dehydrogenation of ethanol to produce H_2 and acetaldehyde



Biomass Derived Carbon Based Catalysts for the Production and Use of Green Hydrogen

INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

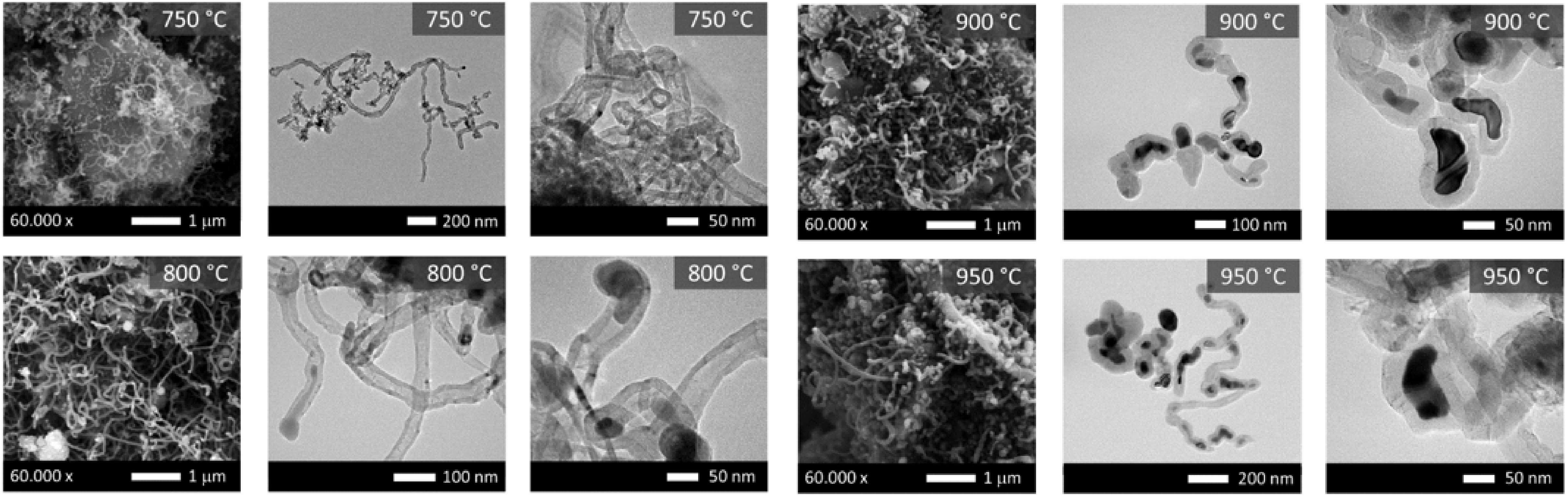




Evolution of CO2 conversion with reaction temperature. 3.61 mol CO2 g.Ni-1·h-1, H2/CO2/N2=4/1/2.

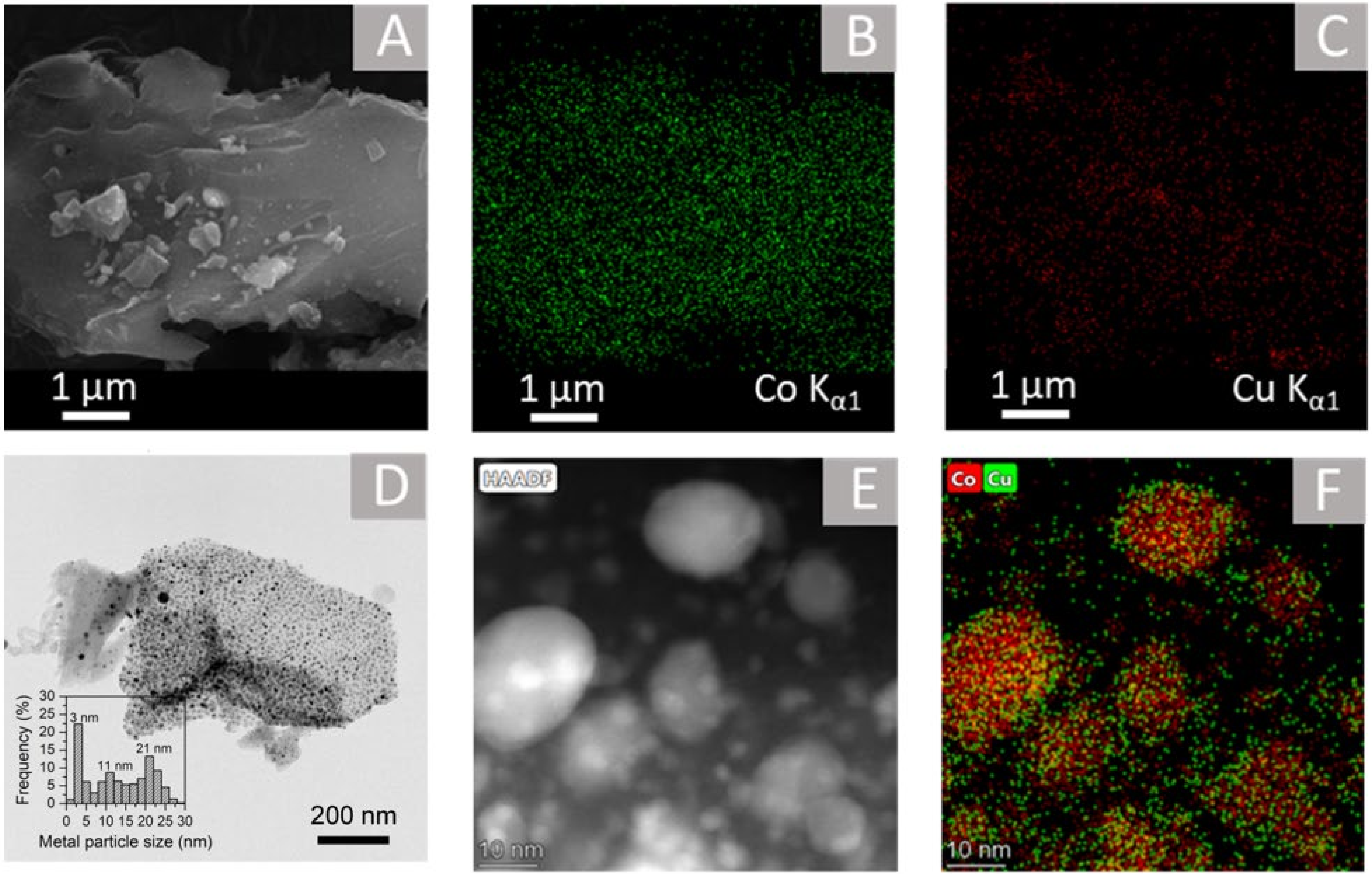
X-EDS maps (B to E) of fresh Ni-Mg-Ce/CDC catalyst.

Biomass Derived Carbon Based Catalysts for the Production and Use of Green Hydrogen



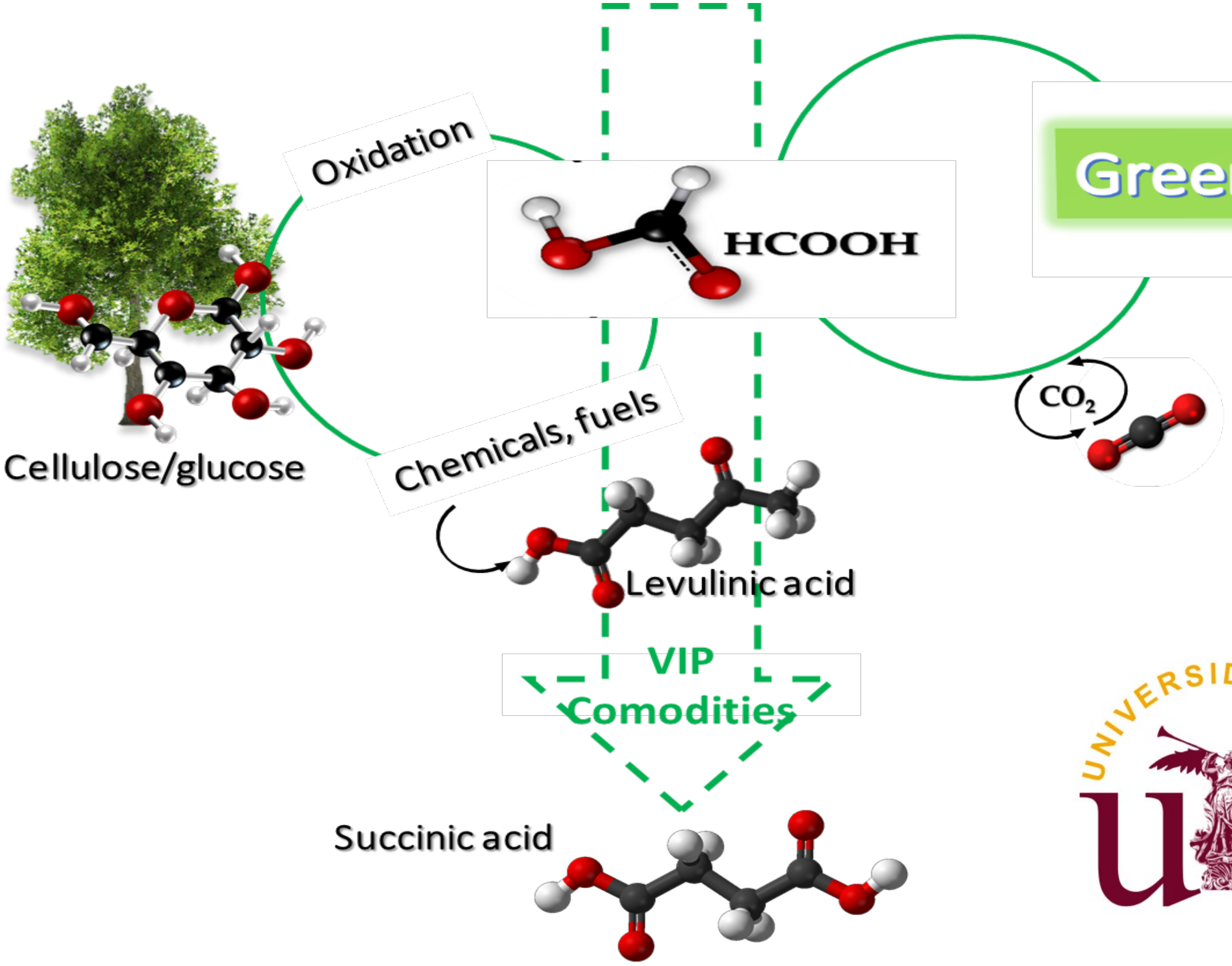
SEM and TEM images of the carbonaceous nanomaterials grown at different reaction temperatures, using a feed gas composition of 28.6% CH4:14.3% H2:57.1% N2

Biomass Derived Carbon Based Catalysts for the Production and Use of Green Hydrogen



Electron microscopy study of the fresh Co-Cu/CDC catalyst: (A) general view-SEM, (B, C) SEM-EDS elemental mapping, (D) TEM image of metal particle size distribution, (E) STEM-HAADF image for morphology and (F) sub-nanometric chemical analysis performed by STEM-EDS.

Formic Acid as Energetic Vector: From Biomass to Green Hydrogen



INMA INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

UNIVERSIDAD DE SEVILLA

ICMS

Formic Acid as Energetic Vector: From Biomass to Green Hydrogen

Objectives

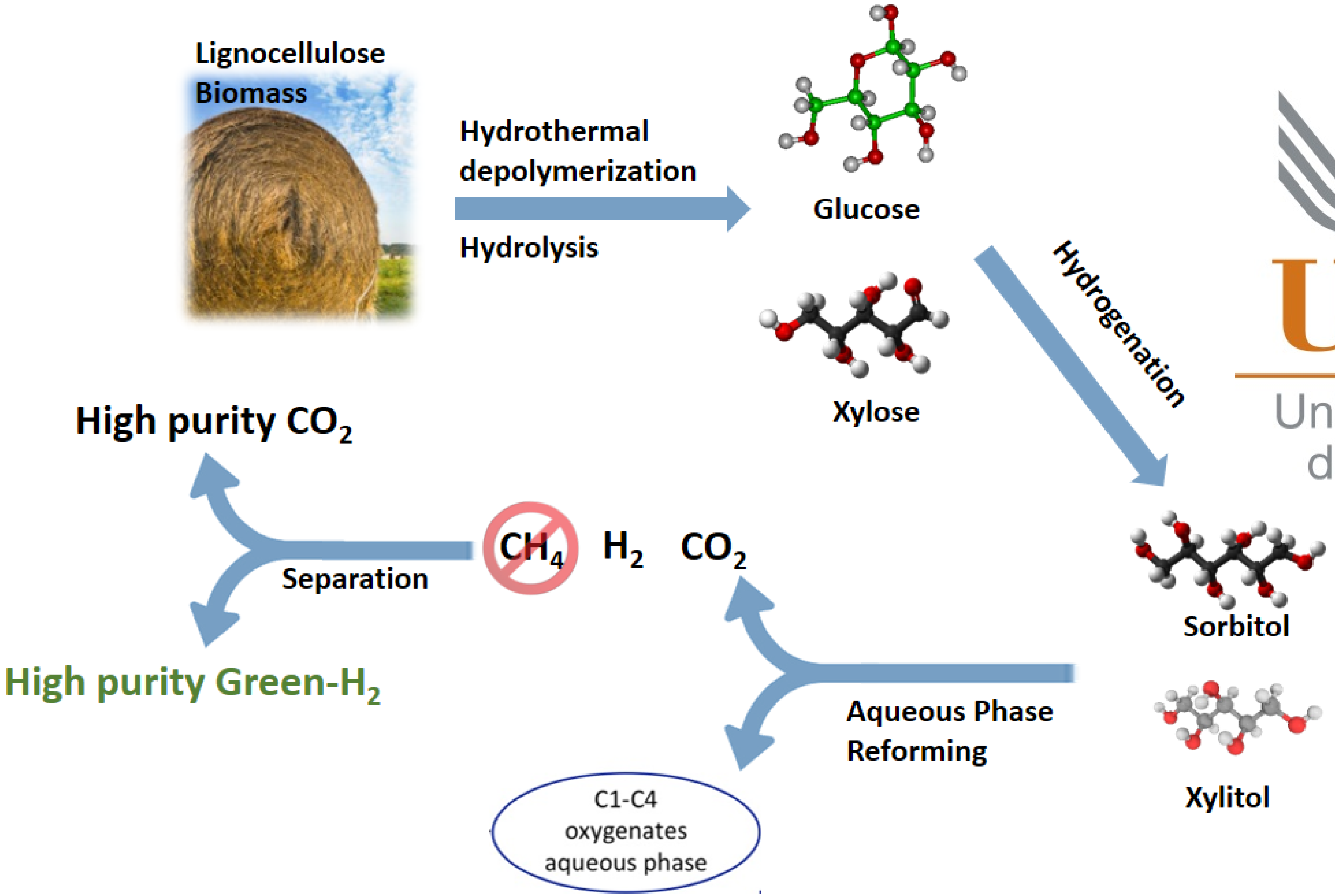
- *To produce formic acid as energy vector directly from a renewable source (lignocellulosic biomass) and to convert it in hydrogen.*
- *Design of new class of economic and efficient heterogeneous catalyst using non-noble metal catalysts supported on biomass derived carbons in all proposed reactions.*
- *Catalytic activity:*
    - *direct transformation of glucose to formic acid or to a levulinic/formic acid mixture*
    - *formic acid dehydrogenation to green hydrogen*
    - *levulinic acid transformation to succinic acid*
    - *gas-phase glucose and levulinic acid oxidation*

INMA
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

UNIVERSIDAD DE SEVILLA

ICMS

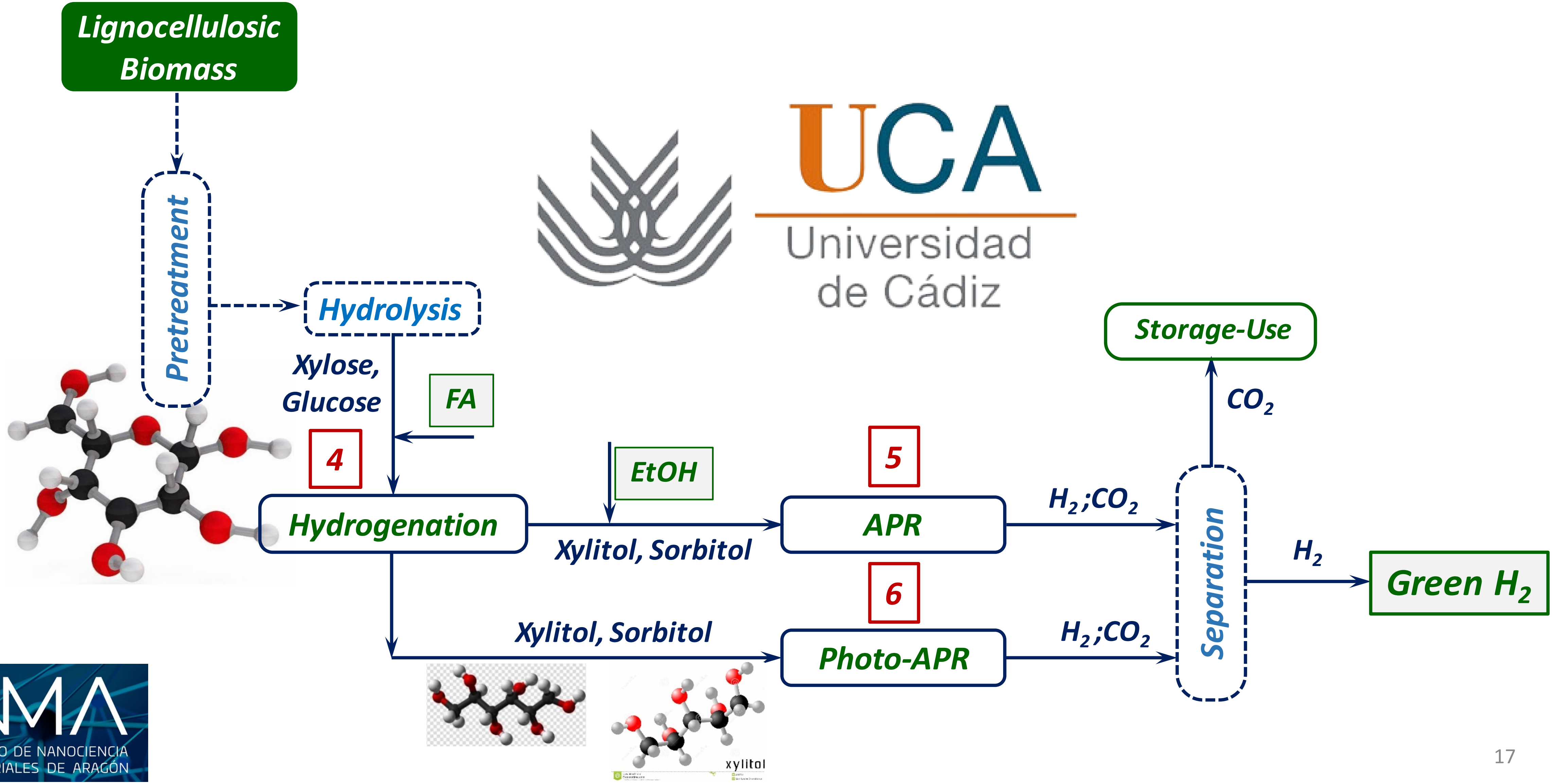
Green Hydrogen Production via Aqueous Phase Catalytic Reforming of Biomass-Derived Compounds



UCA
Universidad de Cádiz

INMA
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

Green Hydrogen Production via Aqueous Phase Catalytic Reforming of Biomass-Derived Compounds



UCA Universidad de Cádiz

INMA INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

Green Hydrogen Production via Aqueous Phase Catalytic Reforming of Biomass-Derived Compounds

Objectives

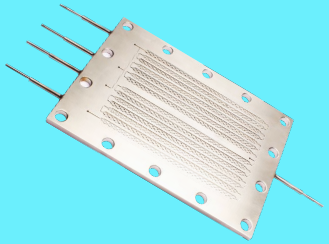
- ✓ *To obtain green hydrogen directly from a renewable source by means of a coupled process of Hydrogenation-Aqueous Phase Catalytic Reforming*
- ✓ *Design of new class of economic and efficient heterogeneous catalyst using non-noble metal catalysts supported on biomass derived carbons in all proposed reactions*
- ✓ *Catalytic activity:*
  - *Glucose Hydrogenation to obtain Sorbitol and Xylitol as precursors of the Aqueous Phase Catalytic Reforming process*
  - *Aqueous Phase Reforming of Sorbitol and Xylitol to* H_2

INMA
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

UCA
Universidad de Cádiz

SteppiNg towards CIrCular Economy: Recycling bio-waste into heavy tRansport BIOFUELS (NICER-BIOFUELS)

FEEDSTOCK	ADVANCED PROCESSES & REACTION ENGIEERING			PRODUCTS & APPLICATIONS
Biowastes & Textile Residues	CH_4-CO_2 separation Biomethane Cracking	CO_2-Gasification & syngas conditioning	Hybrid FTS-Hydrocracking Catalytic upgrading	Heavy Transport Biofuels (HTB)
Carbon dioxide (industrial flue gases)	Hydrogen & Carbonaceous Nanomaterials (CNMs)	Tar abatement & Sulphur removal	Microchannel Reactors & Process Intensification	Decarbonizing the transport sector



PLEC2021-008086

MINISTERIO DE CIENCIA E INNOVACIÓN

Financiado por la Unión Europea NextGenerationEU

Plan de Recuperación, Transformación y Resiliencia

AGENCIA ESTATAL DE INVESTIGACIÓN

INMA INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

SteppiNg towards CIrCular Economy: Recycling bio-waste into heavy tRansport BIOFUELS (NICER-BIOFUELS)

Objectives

- *NICER-BIOFUELS aims to create a unique knowledge infrastructure that supports the decentralized, sustainable and cost-efficient conversion of bio-waste to sustainable Heavy Transport Fuels (HTB) and is relevant to both Spain and EU.*
- *The project targets the development of new technologies that overcome critical technological barriers, increase process efficiency and reduce marginal costs in the waste to HTB conversion process.*

PLEC2021-008086

MINISTERIO DE CIENCIA E INNOVACIÓN

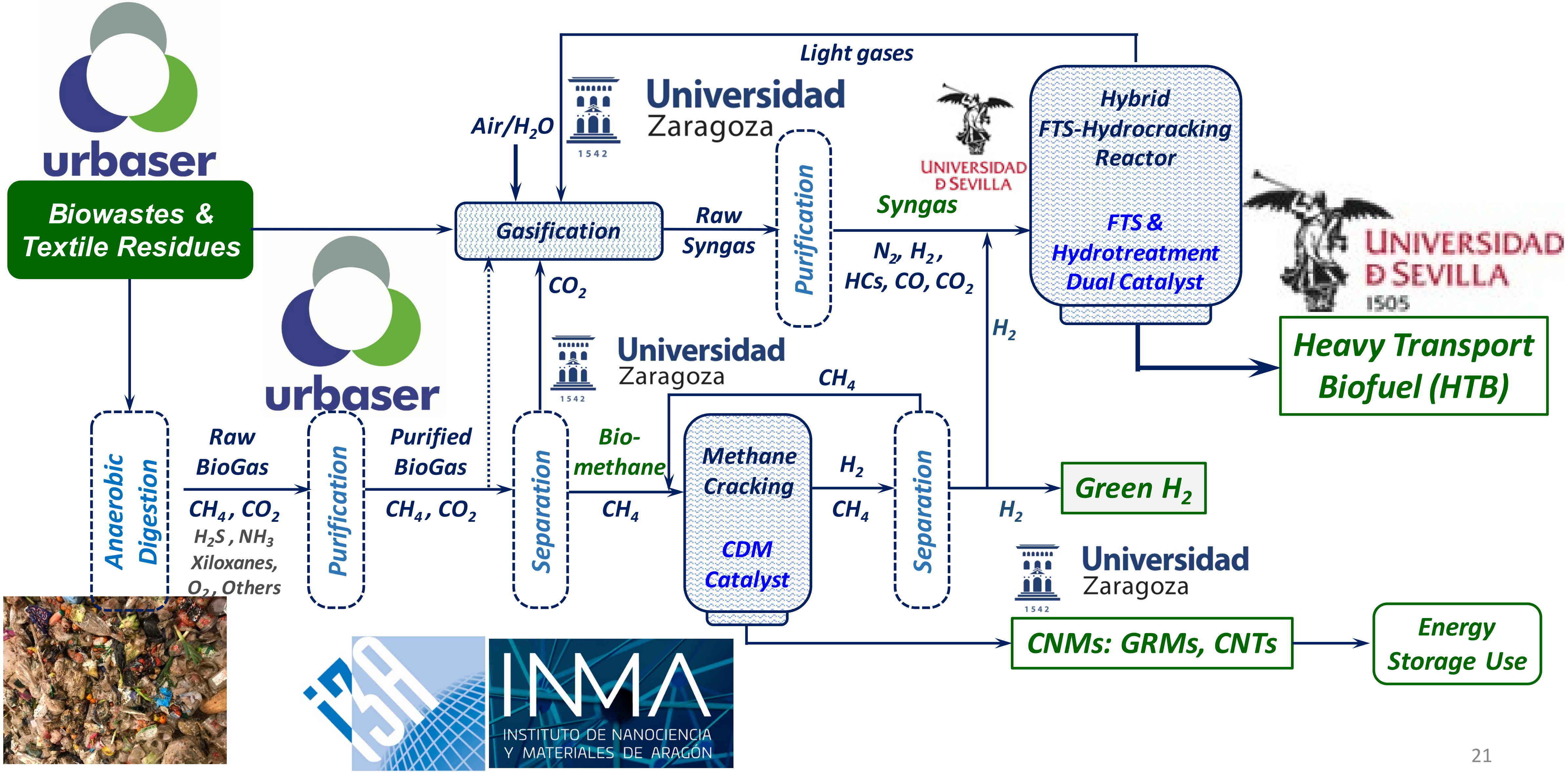
Financiado por la Unión Europea NextGenerationEU

Plan de Recuperación, Transformación y Resiliencia

AGENCIA ESTATAL DE INVESTIGACIÓN

INMA INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

SteppiNg towards CIrCular Economy: Recycling bio-waste into heavy tRansport BIOFUELS (NICER-BIOFUELS)



STRUCTURED UNCONVENTIONAL REACTORS FOR CO2-FREE METHANE CATALYTIC CRACKING (STORMING)

HORIZON-CL5-2021-D2-01-09:

Methane cracking to usable hydrogen and carbon

Horizon Europe

INMA
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

BIOGAS

CH_4 / H_2 separation
CH_4 purification

CH_4 → Reaction: Catalyst

CO_2 ← CO_2 ; H_2O ; H_2 → Regeneration: Catalyst + CNTs

Electrically Heated Fixed Bed Structured Reactors

CH_4 / H_2 separation → H_2 purification → **Hydrogen**

→ CO ; H_2 ; CH_4

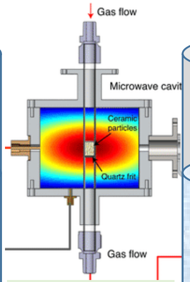
→ **CNTs**

Natural Gas

CH_4 purification

CH_4 → Reaction: Catalyst

CO_2 ; H_2O ; H_2 → Regeneration: Catalyst + CNTs



MW - Heated Fluidized Bed Reactor

CH_4 / H_2 separation → H_2 purification → **Hydrogen**

→ CO ; H_2 ; CH_4

→ **CNTs**


Departamento de Ingeniería
Química y Tecnologías
del Medio Ambiente
Universidad Zaragoza
1542
INMA
INSTITUTO DE NANOCIENCIA
Y MATERIALES DE ARAGÓN
Muchas gracias por su atención!