ECOLEFINS

co-ionics for carbon negative petrochemicals

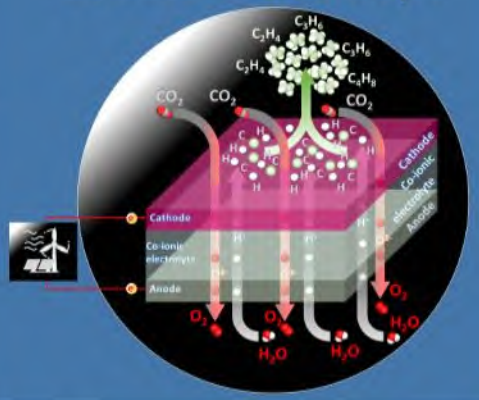
disconnect light olefins ($C_{2-4}^{=}$) from petroleum

scientific breakthroughs

- H^+ supply correspond to activities of extremely high pressures
- control H_2 flooding for CH_4 byproduct minimization
- O^{2-} removal to suppress H_2O/CO byproducts and shift conversion
- increase $C_{2-4}^{=}$ selectivity

CO_2/H_2O co-electrolysis and CO_2 hydrogenation to $C_{2-4}^{=}$ in **co-ionic Electrochemical Membrane Reactors** (ci-EMRs)

ECOLEFINS concept



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HORIZON-EIC-2022-PATHFINDER-01
101099717 ECOLEFINS
EISMEA funding: 2.5 M€
Duration: 10/23 – 9/26
EU

CO_2 to $C_{2-4}^{=}$ benchmark (@ 30 bar):

$$nCO_2 + nH_2 \leftrightarrow C_nH_{2n} + 2nH_2O$$

ECOLEFINS' ci-EMR (1 bar):

$$nCO_2 + 2nH^+ + 6ne^- \leftrightarrow C_nH_{2n} + 2nO^{2-}$$

electrochemically supply protons (H^+) and remove O^{2-} to/from CO_2

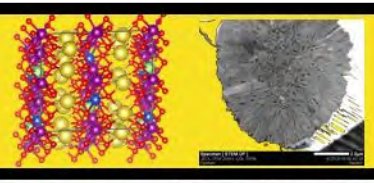
integrate electrolysis endothermicity with CO_2 hydrogenation exothermicity

- bypass H_2 compression
- electrolysis at >400 °C
- increase $C_{2-4}^{=}$ yield
- reduce energy demand

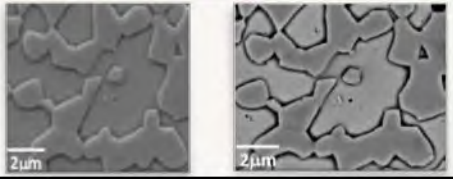
reverse 5 – 11 tn CO_2/tn $C_{2-4}^{=}$ emissions to -3 tns CO_2/tn $C_{2-4}^{=}$ capture

innovations

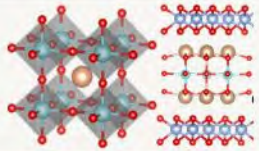
DFT designed co-ionic membranes and electrified interfaces



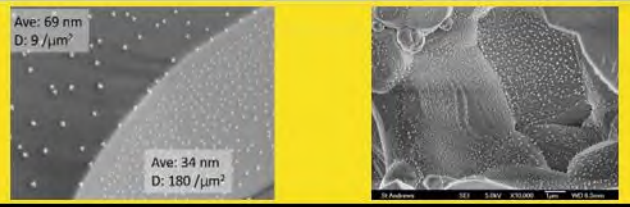
dual phase (cer-cer) membranes of co-ionic conductivity



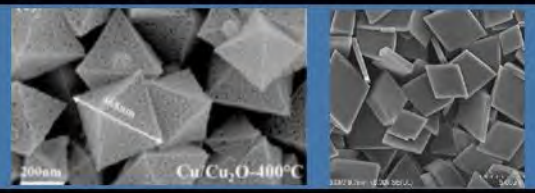
electrodes of triple phase (H^+, O^{2-},e^-) conductivity



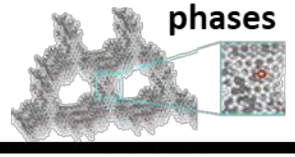
exsolutions, for confided and dispersed catalytic nanoparticles



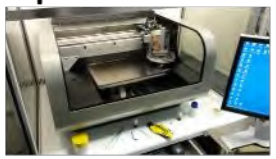
MOF-derived (bi)metallic, catalytic nanoparticles



COF-derived conductive graphitic phases



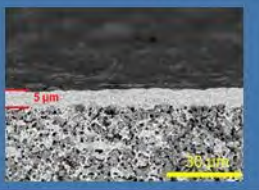
inkjet printing for planar stacks



integrated approach

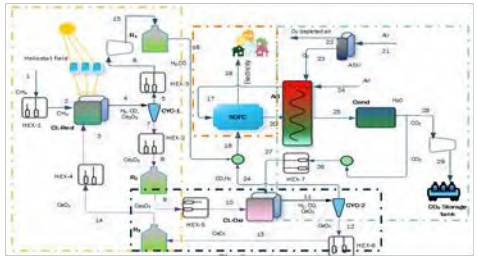
Co-ionic Electrochemical Membrane Reactors (ci-EMRs) up-scaling

ci-EMR planar stacks



ci-EMR tubular modules

planar stacks and tubular modules testing



Integrated ECOLEFINS process modelling

CFD modelling

economic feasibility and sustainability assessment

LCSA and social-LCA

public awareness and social acceptance

market opportunities of ECOLEFINS processes, ceramics and electrochemical components