

Electrocatalytic CO_2 Reduction on CuZnAl-based Oxide Catalysts: Tuning of the H_2/CO Ratio

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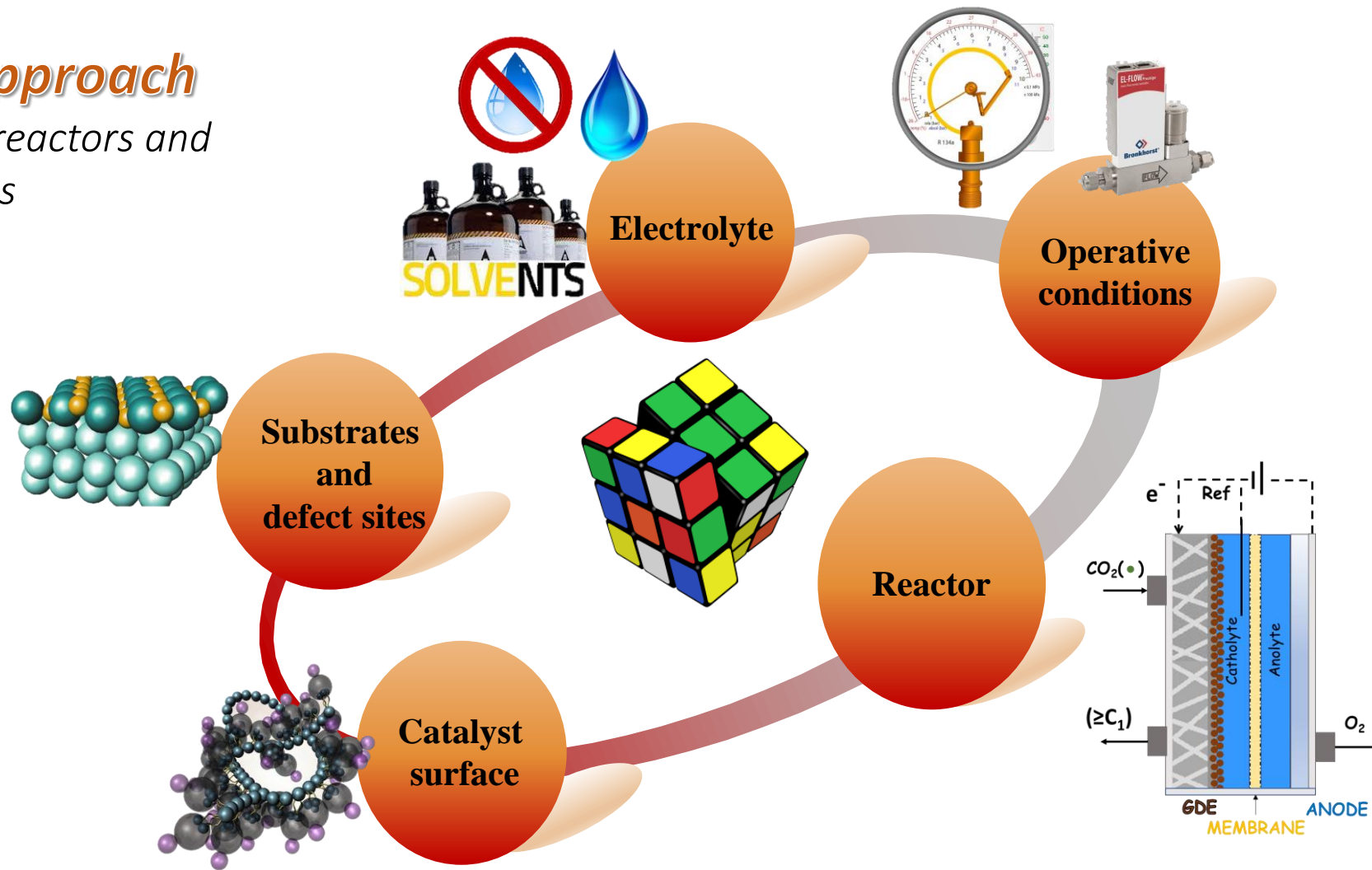
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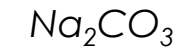
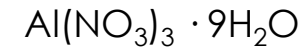
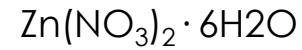
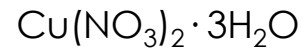
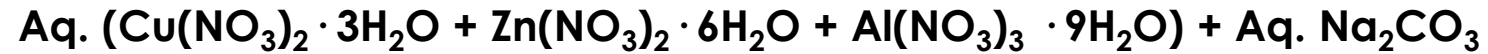


*Multidisciplinary approach
for engineering of catalysts, reactors and
process conditions*





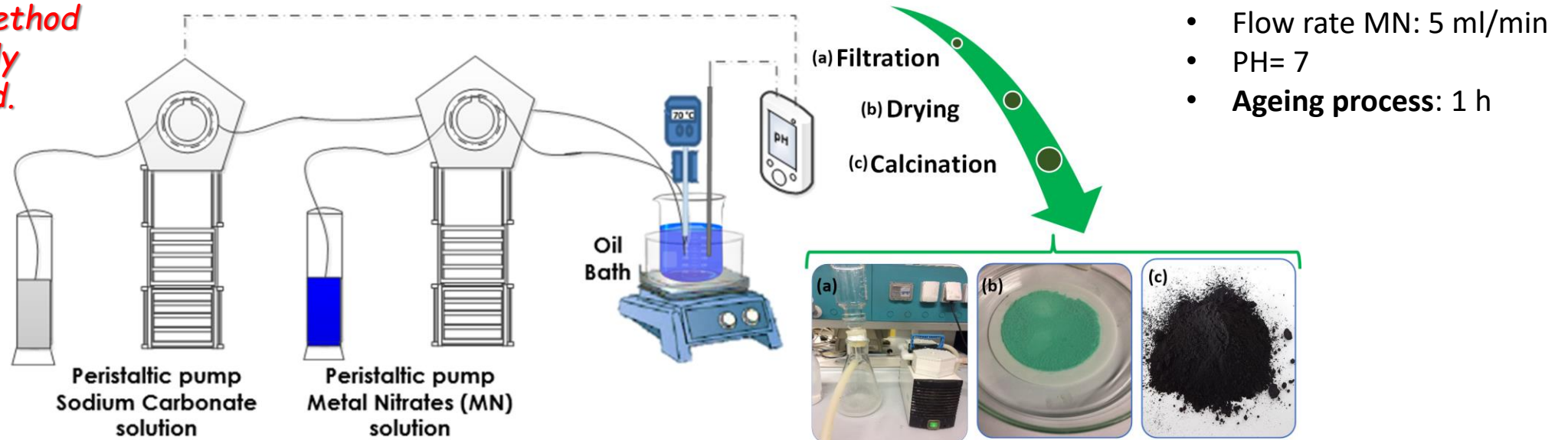
Reagents



- Basic precipitating agent
- Constant pH

Co-precipitation setup

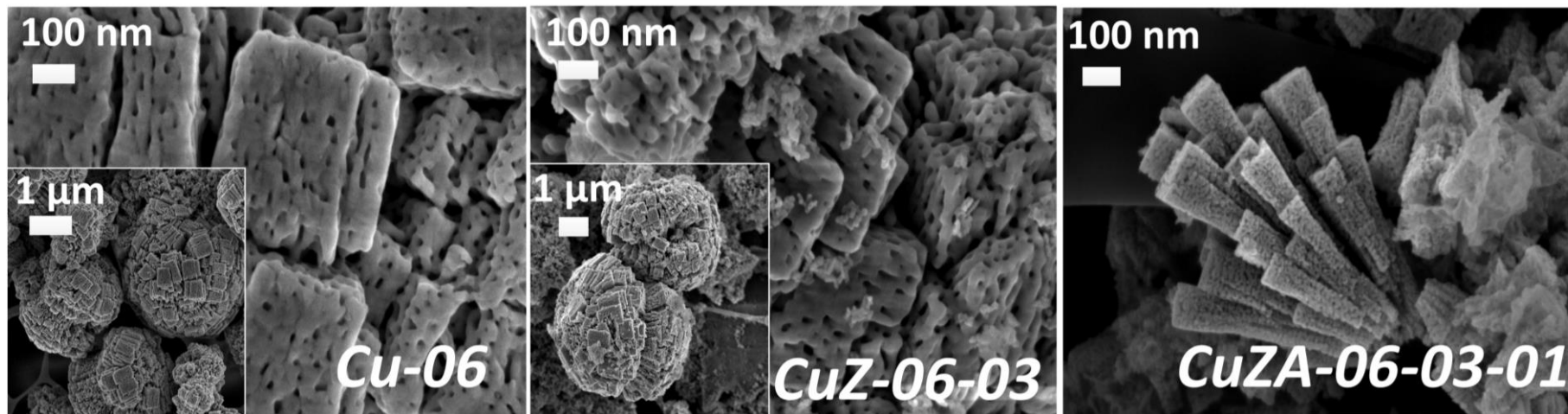
The synthesis method has been fully standardized.



Synthesis adapted from: C. Baltes, et al., Journal of Catalysis 258 (2008) 334–344



Physicochemical properties

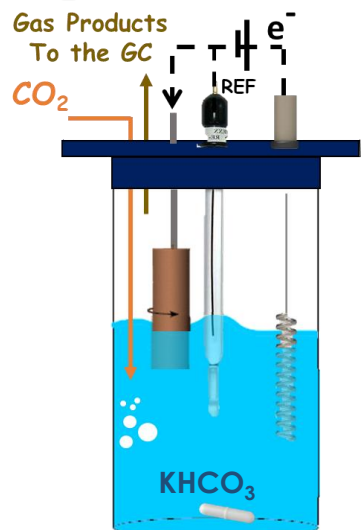


Catalyst	BET surface area, $\text{m}^2 \text{g}^{-1}$	Total pore volume, $\text{cm}^3 \text{g}^{-1}$	EDS, atomic ratio	Crystallite size, nm (11-1) CuO	Superficial $\text{Cu}^0 + \text{Cu}^{1+}$ (rest is Cu^{2+})
Cu-06	18.4	0.11	Cu/O 1:1	17	22%
CuZ-06-03	55.16	0.23	Cu/Zn 60:40	7	8%
CuZA-06-03-01	101.65	0.37	Cu/Zn/Al 60:30:10	9	5%

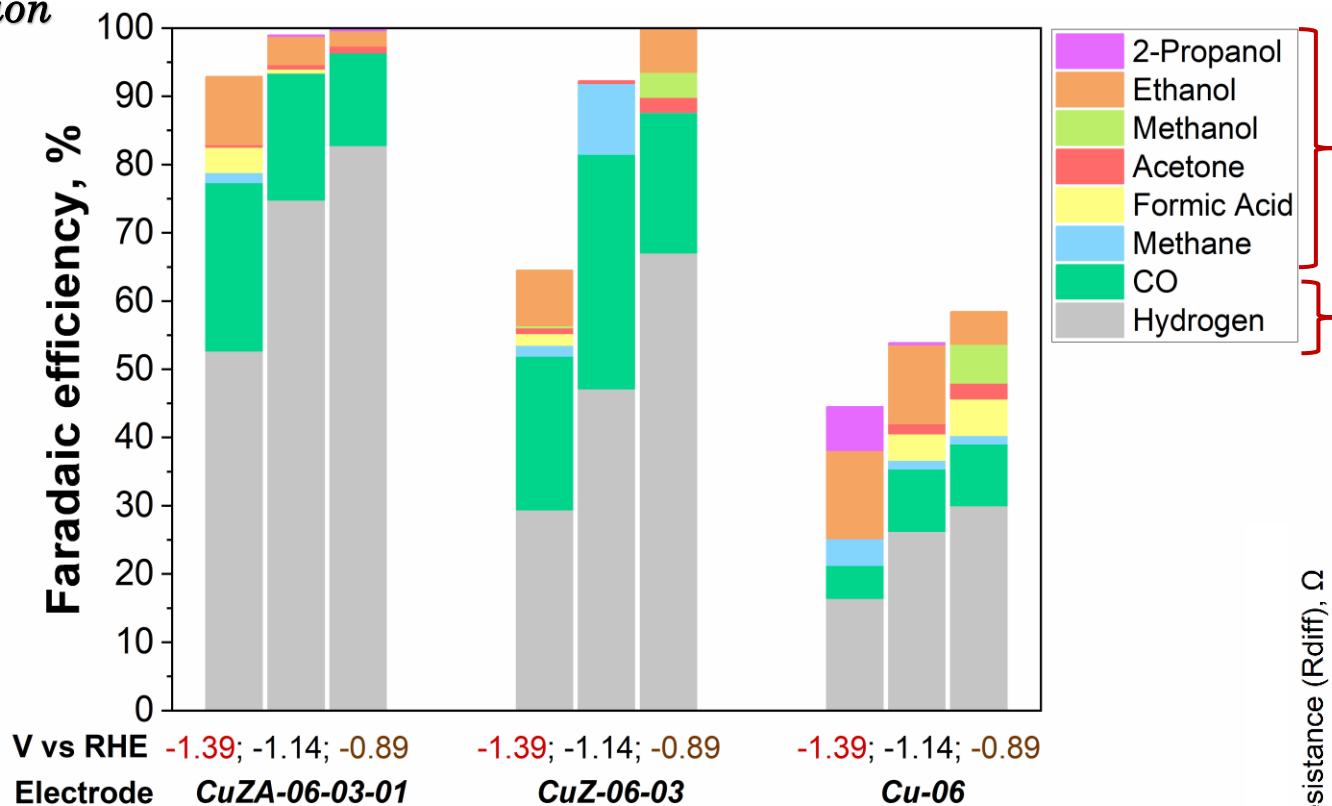
Guzman H., Hernández S., et. al. Catalysis Today, submitted.

EC CO_2 R to syngas and oxygenated products

CO_2 -saturated solution



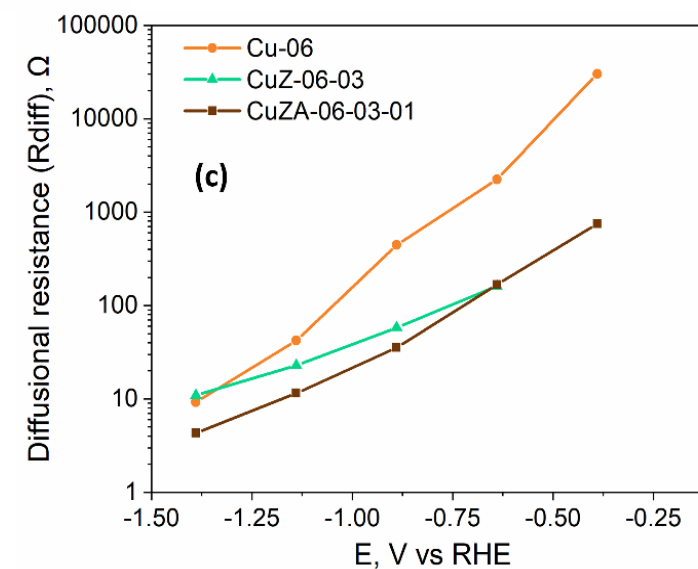
25 °C, 1 Bar



All the catalysts produce:
 C_1 to C_3 oxygenated products

Syngas

CuZA-06-03-01: diffusion is less hindered



More CO_2 reduction products

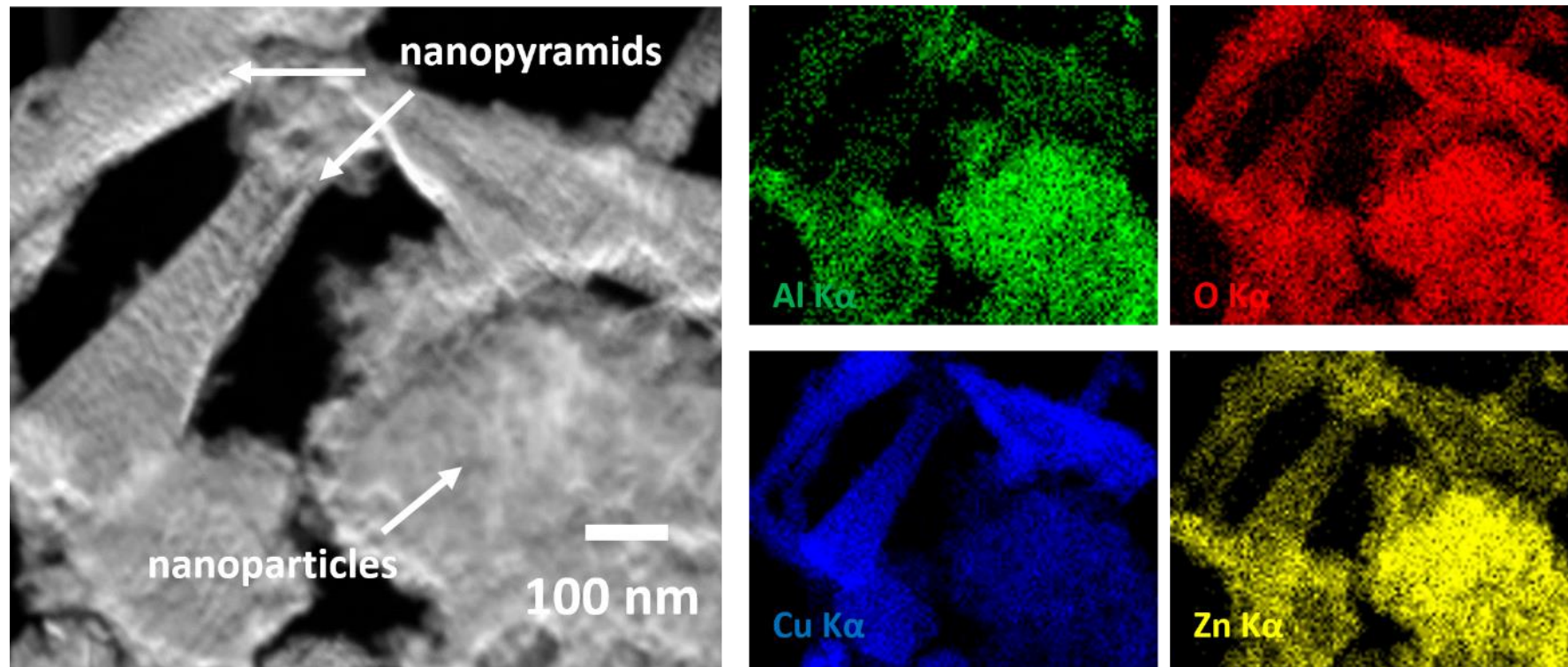


EC CO₂R to syngas and oxygenated products

Role of ZnO & Al₂O₃ on CO₂ electro-reduction

- ↑ surface area, ↑ dispersion of the Cu active phase & ↓ CuO crystals size (< 10 nm)

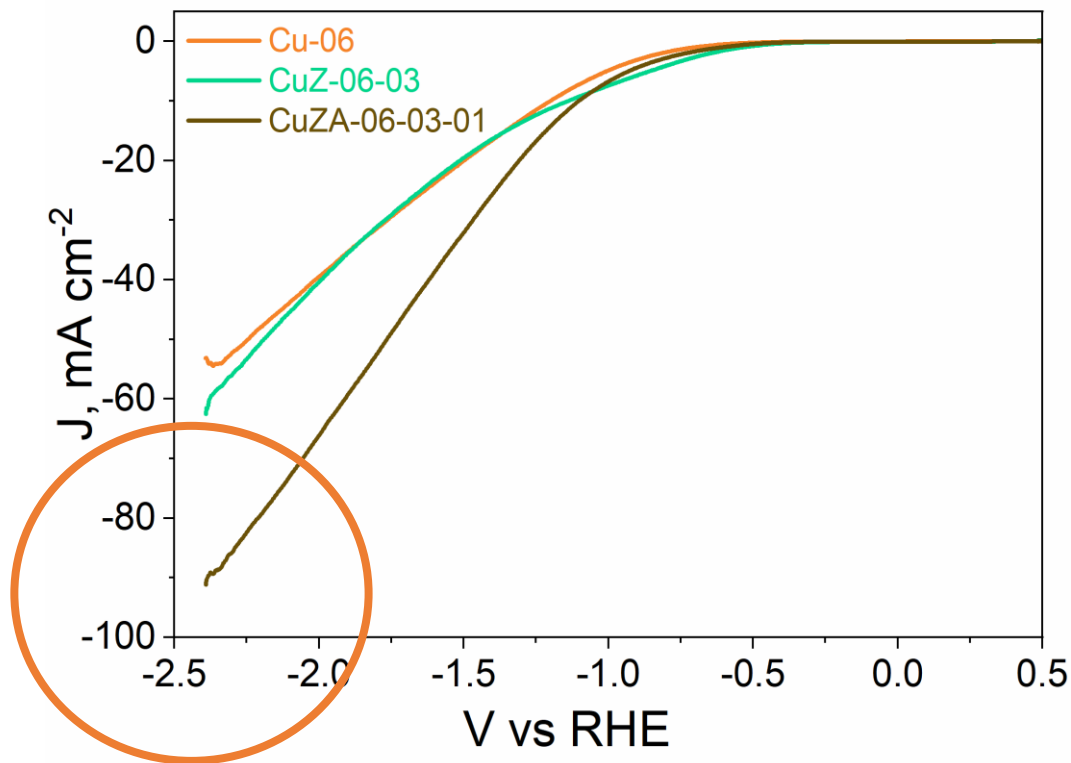
CuZA-06-03-01



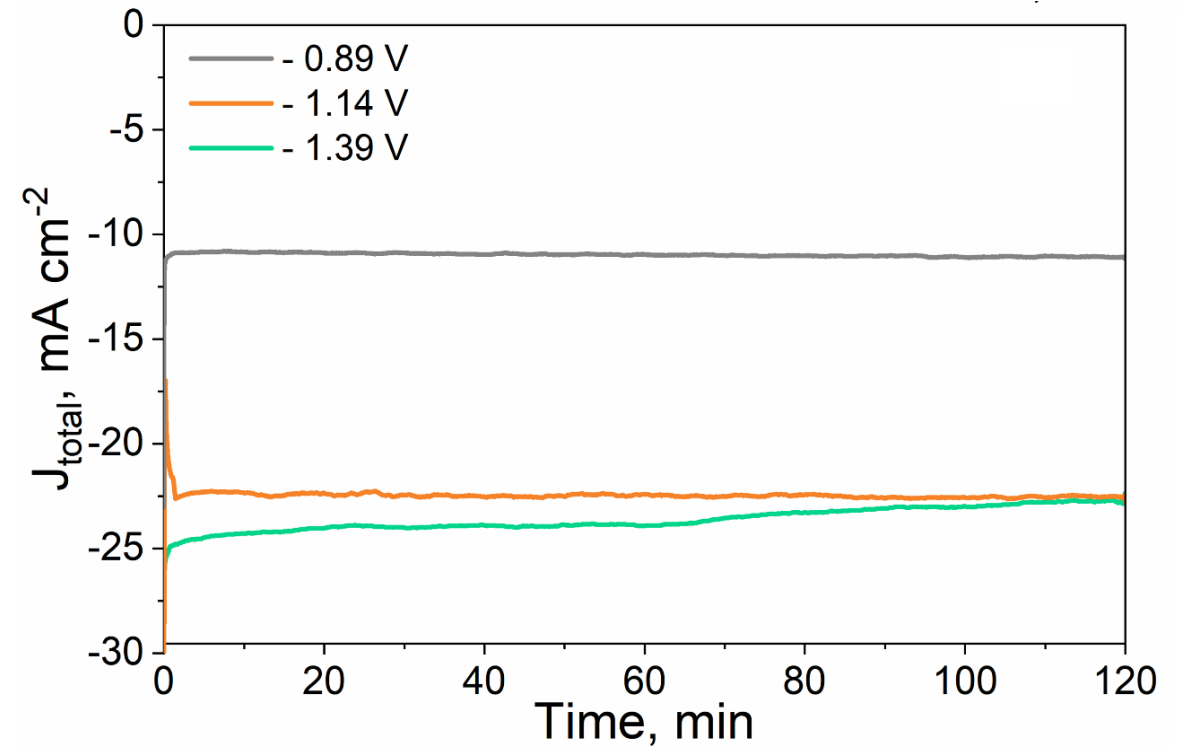
EC CO_2R to syngas and oxygenated products

Role of ZnO & Al_2O_3 on CO_2 electro-reduction

- \uparrow catalytic activity & \uparrow stability
- Industrially relevant current densities (up to **90 mA/cm^2**)



CuZA-06-03-01

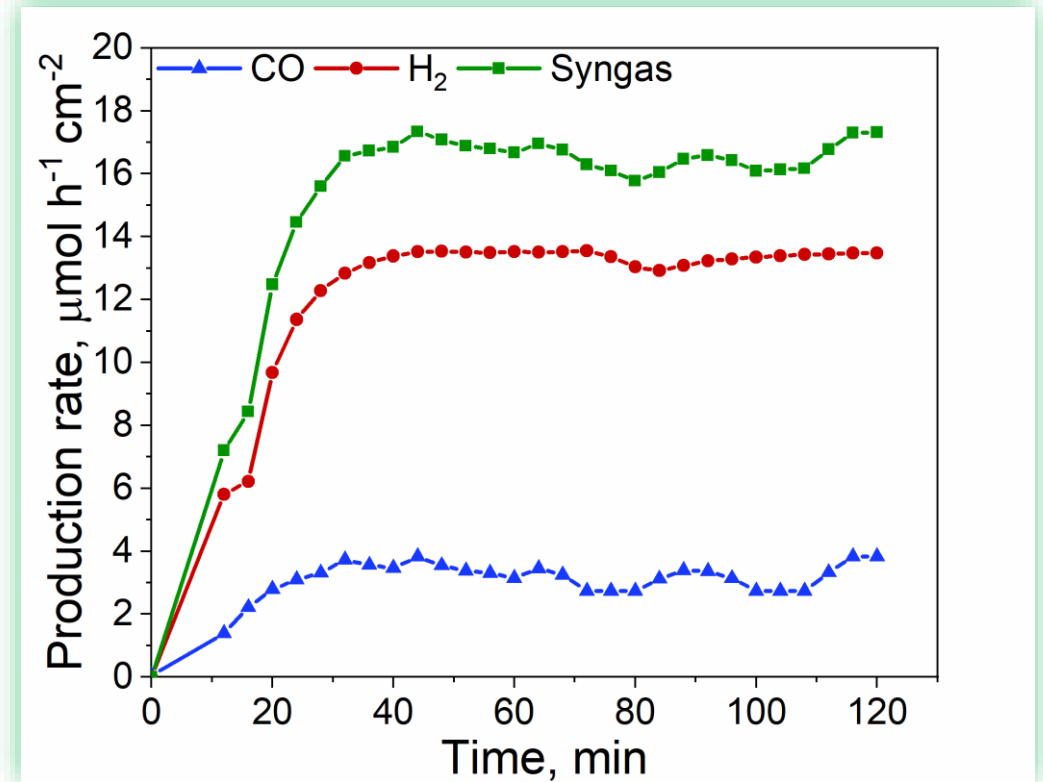
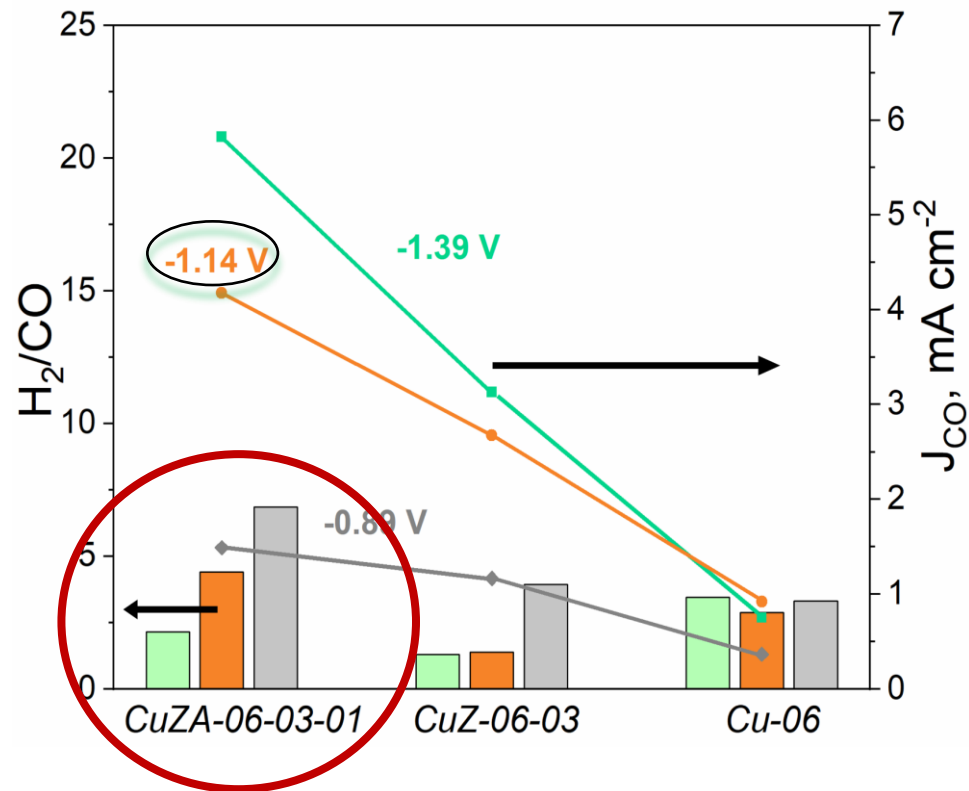




EC CO_2 R to syngas and oxygenated products

Role of ZnO & Al_2O_3 on CO_2 electro-reduction

- \uparrow selectivity towards syngas (H_2 and CO) formation than bare Cu
- Tuneable H_2/CO ratio (with CuZA-06-03-01) by changing the applied potentials





Politecnico
di Torino



THANKS!



Do you have any questions?



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