XIII JORNADAS DE JÓVENES INVESTIGADORES DEL I3A

INFLUENCE OF THE CALCINATION ATMOSPHERE ON COPPER-ALUMINUM CATALYSTS FOR THE SELECTIVE DEHYDRATION OF GLYCEROL

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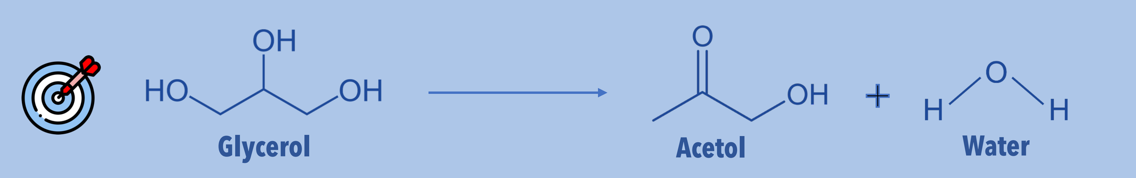
CONTEXT

The aviation sector consumes **10.4% of the world's petroleum** [1]. To achieve the goal of zero net carbon emissions by **2050**, the development of sustainable aviation biofuels (SAF) is necessary.

Sugar to Jet. Fuels (STJ) is a promising new route that uses biomass-derived furfural as feedstock for SAF production. However, acetol is used in an aldol condensation step and is made from fossil resources [2].

Glycerol, generated as a by-product in the biodiesel manufactured by transesterification of vegetable oils and animal fats, is proposed as feedstock for acetol production by dehydration [Eq. 1].

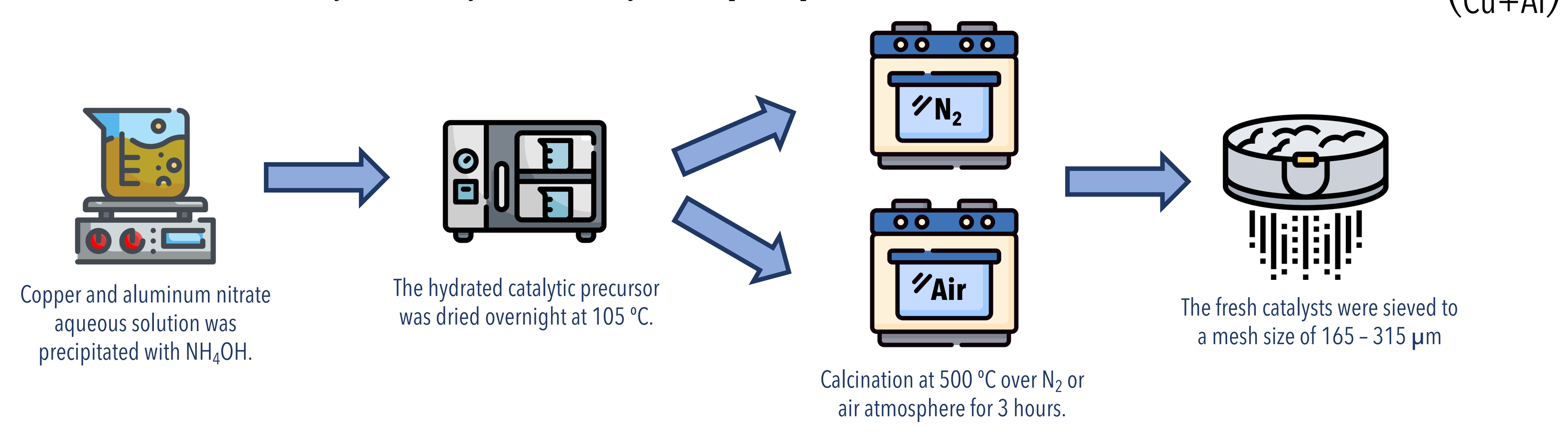


[Eq. 1]

This work studied the influence of the **calcination atmosphere** (nitrogen or air) in CuAl catalysts for the catalytic production of **acetol** from glycerol, a renewable resource.

METHODOLODY

The CuAl catalysts were synthesized by the **coprecipitation** method with 28% molar of Cu defined as $\left(\frac{Cu}{Cu+Al}\right)$.



Operating conditions

- Atmospheric pressure, gas phase experimental plant (Fig. 1)
- Temperature: 250 °C
- W/m ratio of 30 g_{Cat} min $g_{Glycerol}^{-1}$
- 10 wt.% glycerol aqueous solution

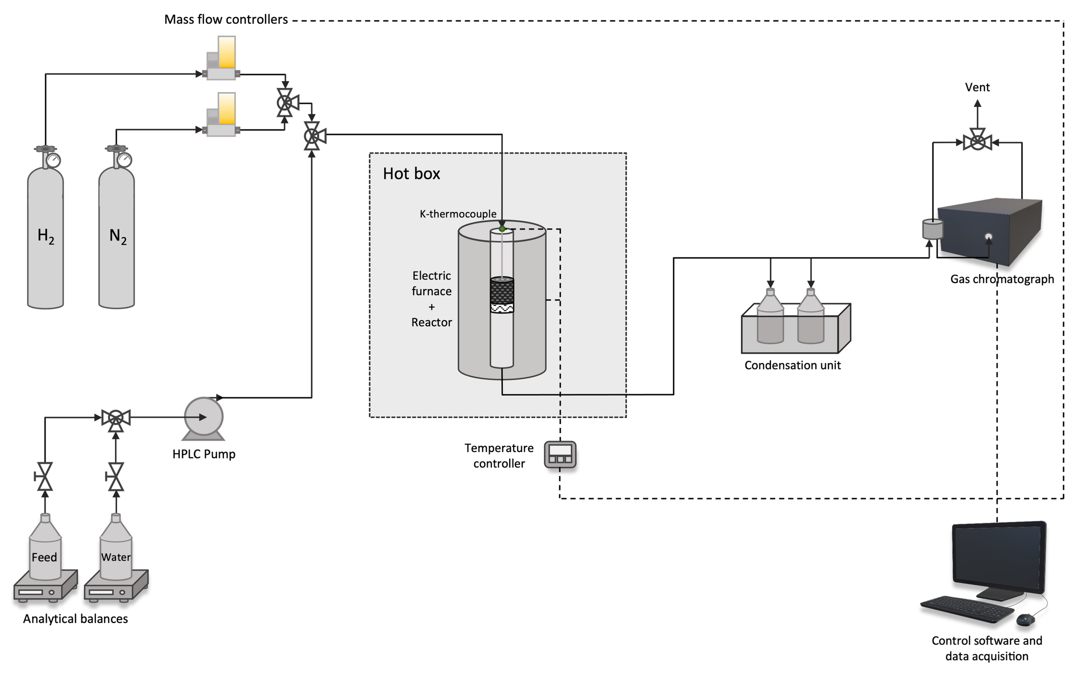


Figure 1. Laboratory scale experimental plant [3].

CATALYTIC ACTIVITY

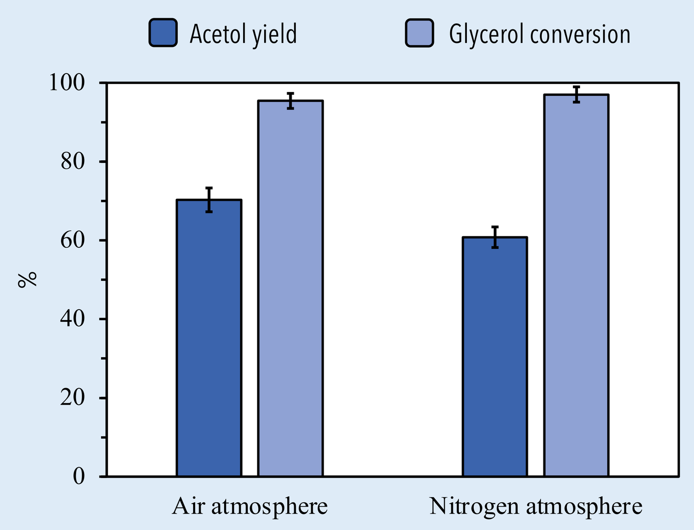


Figure 2. Catalytic performance of CuAl catalysts.

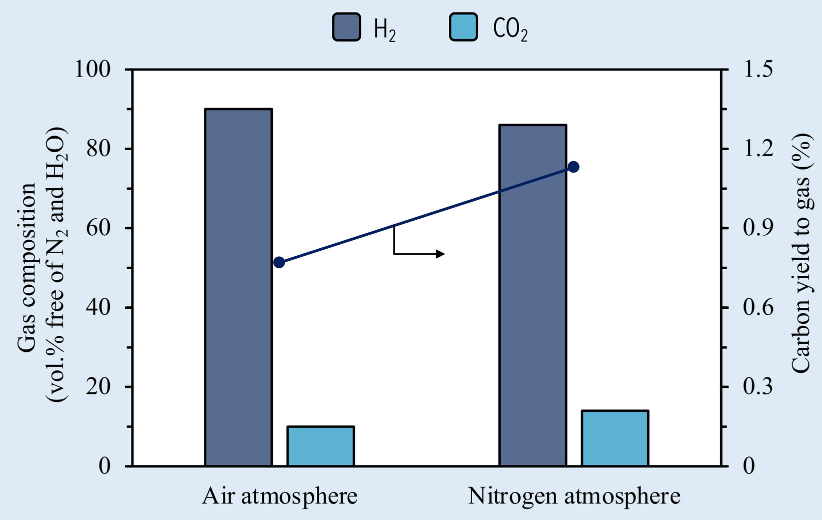


Figure 3. Gas composition and yield with the CuAl catalysts.

CHARACTERIZATION

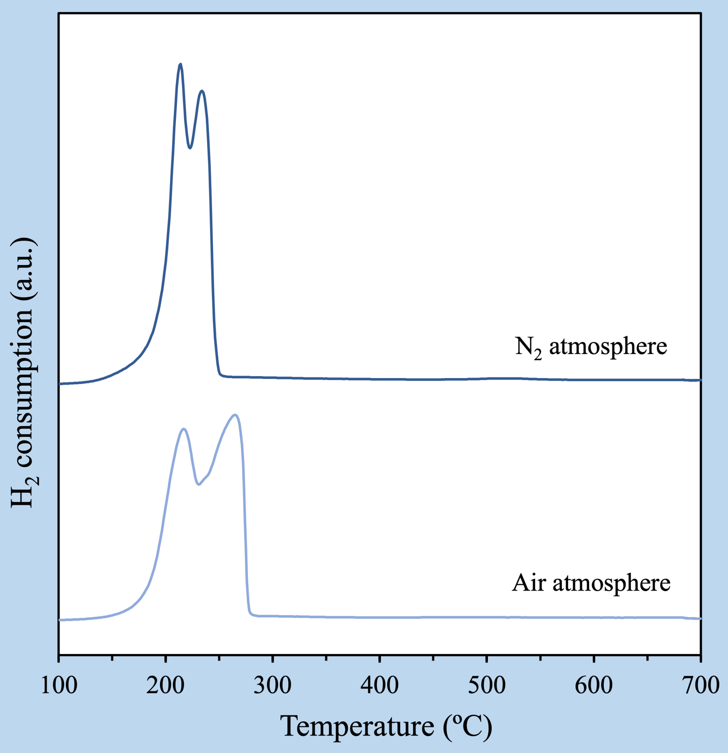


Figure 1. H_2-TPR pattern of fresh catalysts.

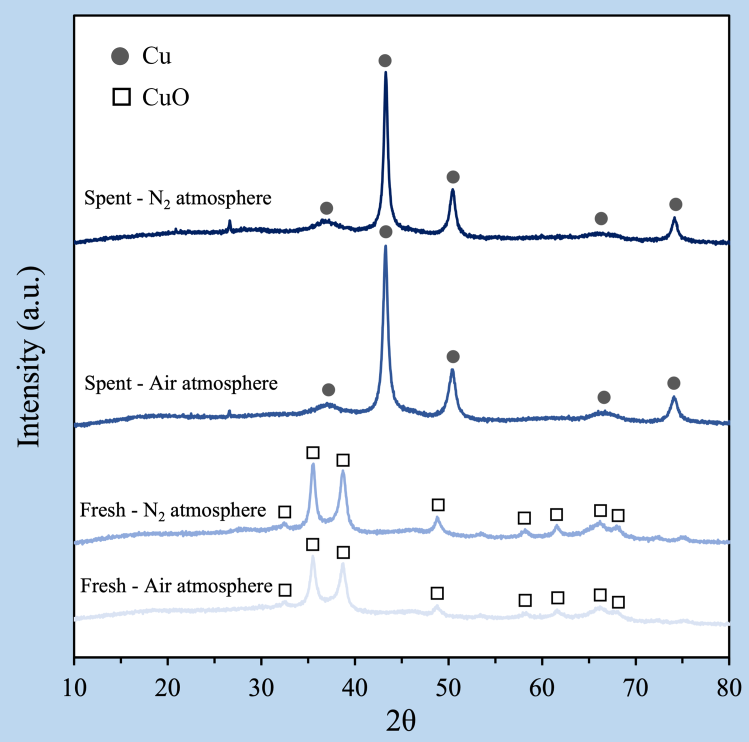


Figure 2. XRD profiles of fresh and spent catalysts.

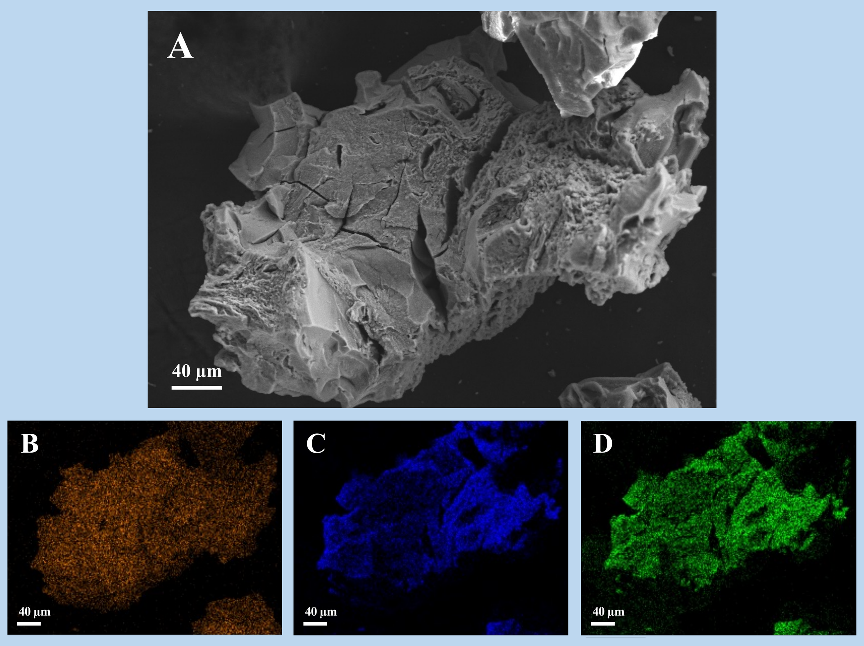


Figure 3. FESEM of fresh catalyst calcined in air atmosphere (A) and EDS mapping of copper (B), aluminum (C), and oxygen (D).

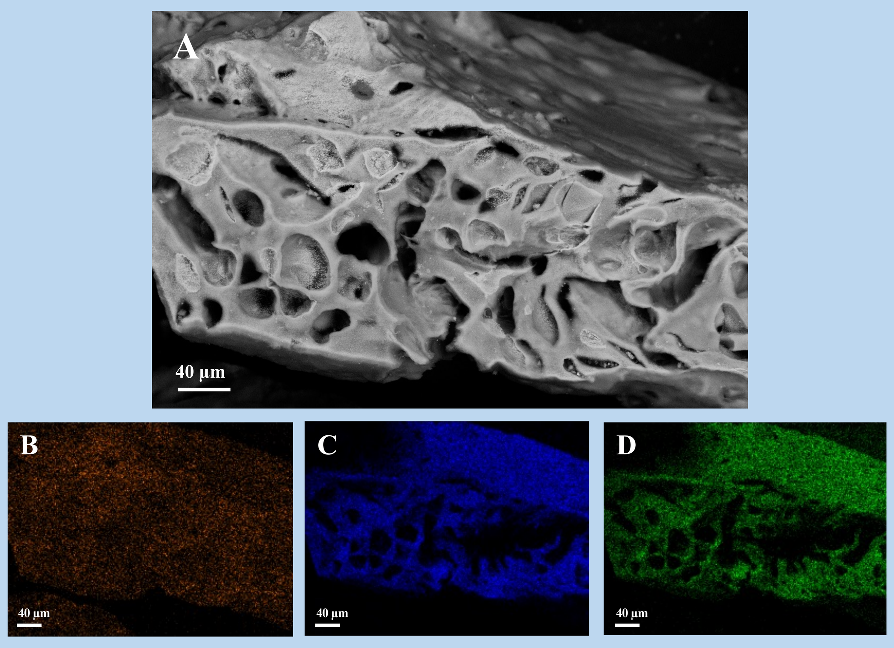


Figure 4. FESEM of fresh catalyst calcined in nitrogen atmosphere (A) and EDS mapping of copper (B), aluminum (C), and oxygen (D).

Table 1. Textural properties of fresh and spent catalysts.

Catalyst	S_{BET} (m^2 g^{-1})	V_P (cm^3 g^{-1})	d_P (nm)	D_{XRD}[a] (nm)
Fresh – Air	224.5	0.40	6.73	13.4
Fresh – Nitrogen	226.7	0.48	6.26	14.5
Spent - Air	219.5	0.36	5.79	14.7
Spent – Nitrogen	165.8	0.34	6.76	18.5

[a] Particle CuO and Cu size for the fresh and spent catalysts, respectively. Calculated from XRD patterns by Scherrer equation.

CONCLUSIONS

- The calcination atmosphere influenced the physicochemical properties of the CuAl catalysts.
- Calcination in N_2 atmosphere lowered the reduction temperature of Cu but reduced its dispersion.
- The air atmosphere generated better textural properties after the reaction.
- The catalyst calcined in air atmosphere improved the acetol yield to 71.0 %.

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[3] Lete, A., Raso, R., García, L., Ruiz, J. and Arauzo, J. *Synthesis of ketones from glycerol and 1,2-propanediol using copper and nickel catalysts: Unraveling the impact of reaction phase and active metal*. Fuel. 2024, 371(A), 132001.

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