Graphene applications to PEM fuel cell technology

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Introduction

The most important issues for the correct operation of PEMFCs are thermal and water management inside the cell. The rapid evacuation of the generated water from the electrodes allows better mass transport and increases the device performance. The application of graphene or its derivatives in certain parts of the cell is expected to improve water management, making use of its modifiable wettability, while not increasing the resistance for the generated current. Furthermore, its application as protective coating against corrosion has recently been considered. This property can be used in fuel cells to protect current collector plates or grids in the cells without producing contaminating corrosion products.

Objective

Graphene surfaces on current collectors apply to PEM fuel cells

Planning

Synthesis methods		Optimization	Characterization
Supported graphene films are obtained by reduction of GO solutions on different substrates (Cu, Ni and Zn).	Unsupported graphene films are obtained by reduction of self-supported films of GO using hydrazine or CO_2 laser beam.	Analysis of graphene properties obtained by each method. Influence of different variables on films quality.	Electrochemical corrosion tests and water contact angle measurements to analyze their hydrophobicity.

Reactions

$$Cu + GO \rightarrow Cu_2O + rGO$$
$$Cu_2O + GO \rightarrow CuO + rGO$$

Graphene grows on the grid covering all its surface. Their thickness increases with the reaction time (Fig.1A).

Cubic crystals are formed initially. Their composition was determined by EDX to be copper (I) oxide, Cu_2O (Fig.1C).

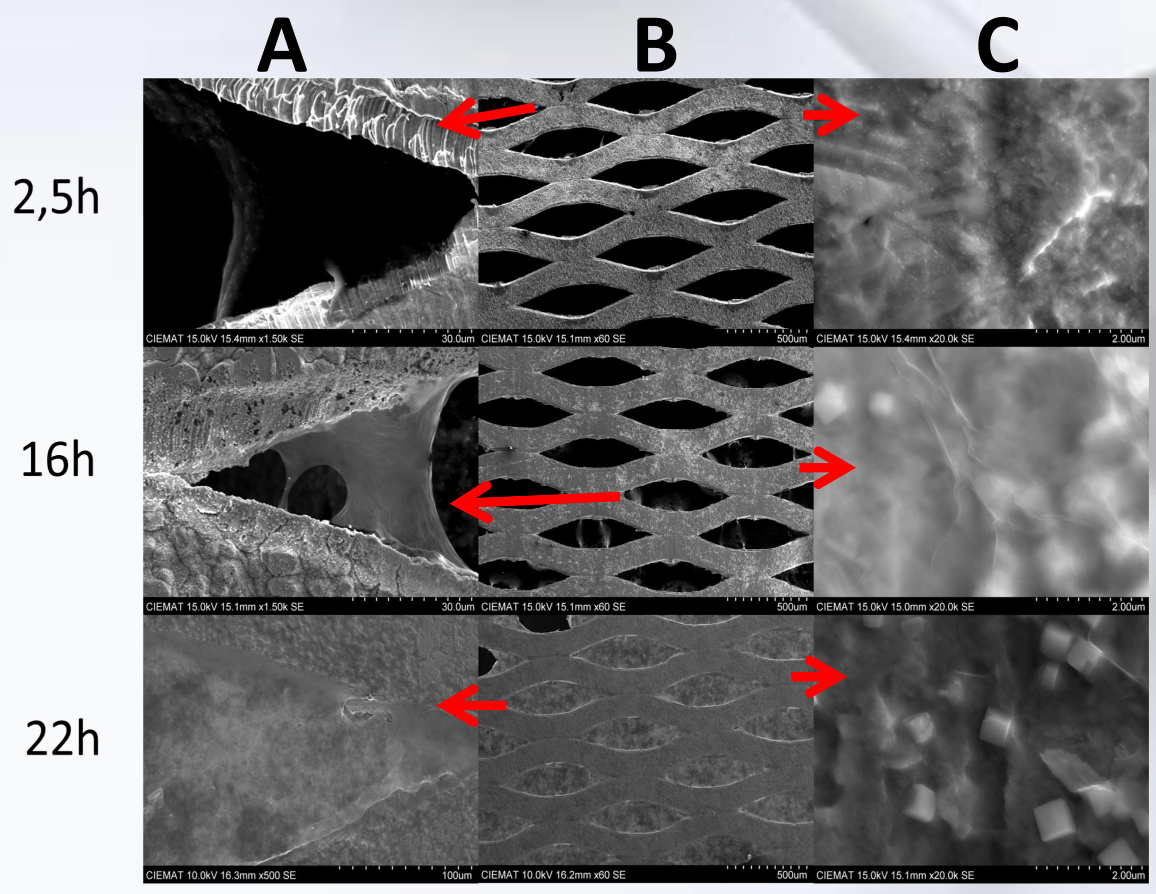


Figure 1.- A y B) SEM images of a copper grid showing the evolution of the formation of the r-GO film with the reaction time. **C)**SEM images of the surface of the supports where appear cuprous oxide crystals covered by a layer of graphene.

To avoid the deposit of copper oxides

Addition of sulfuric acid to the GO solution

Cleaner films are formed that do not trap Cu_2O on the surface (Fig.2A).

Appearance of branched structures (Fig.2B) in the r-GO sheets that extend to cover the voids.

By increasing the amount of sulfuric acid added, the appearance of this type of branching on the grid itself was also observed (Fig.2C).

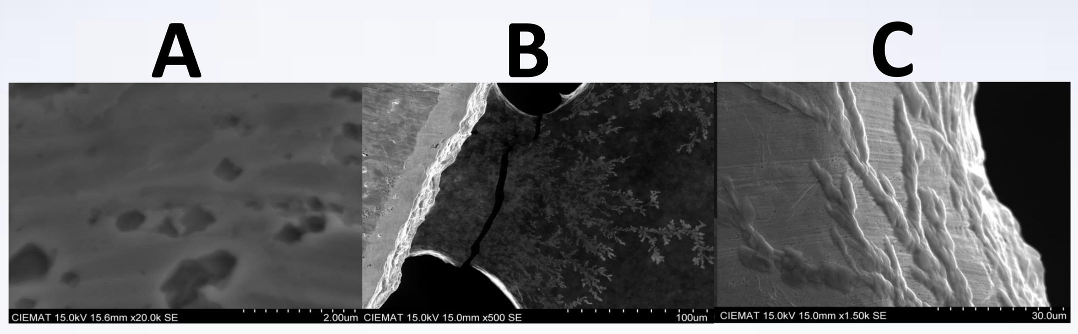
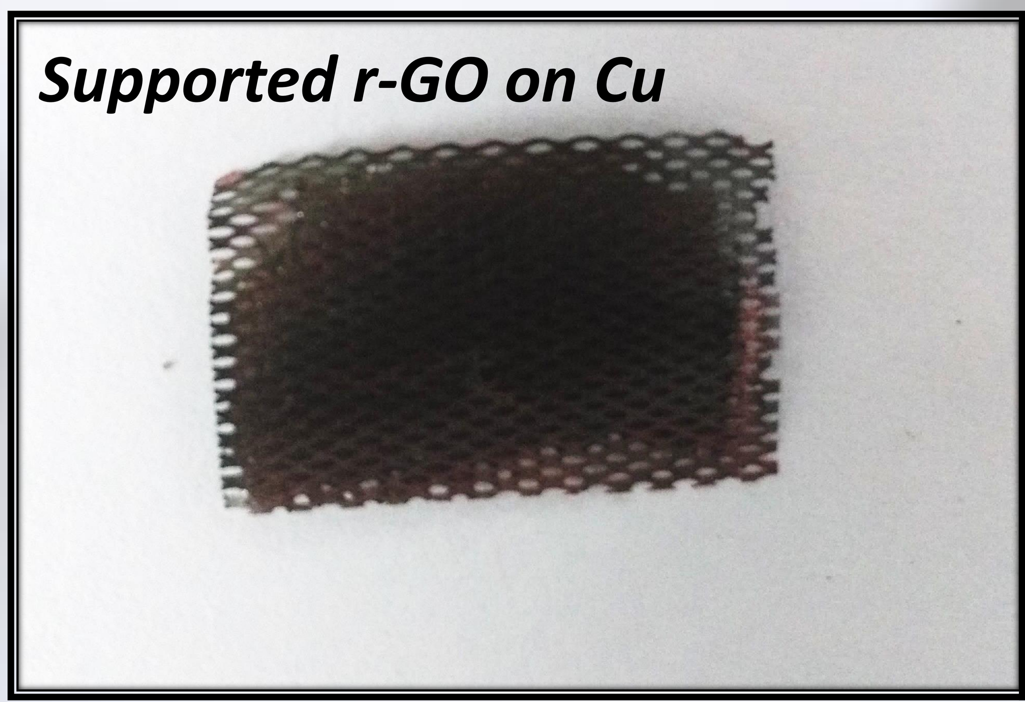
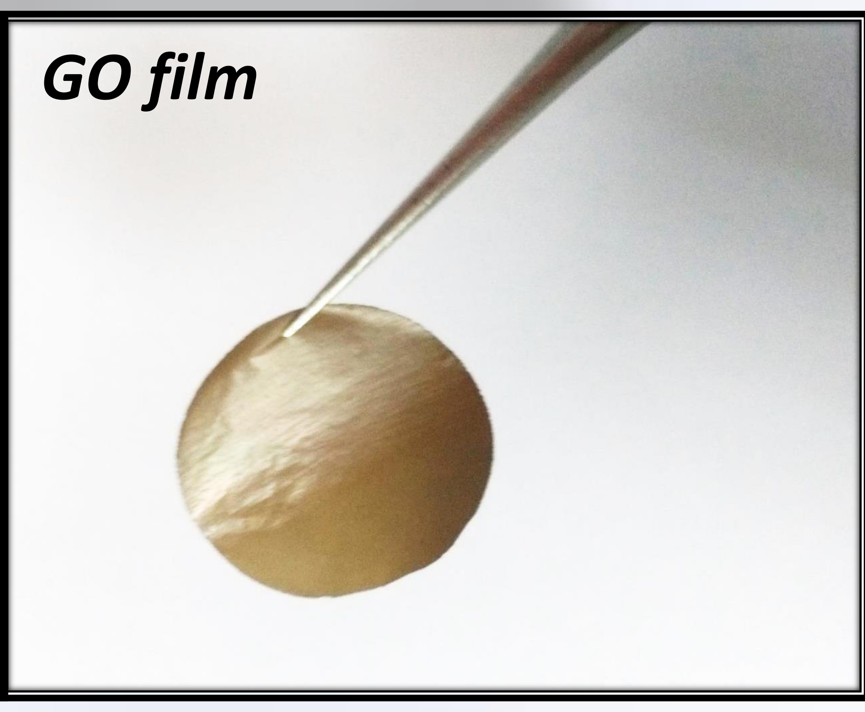
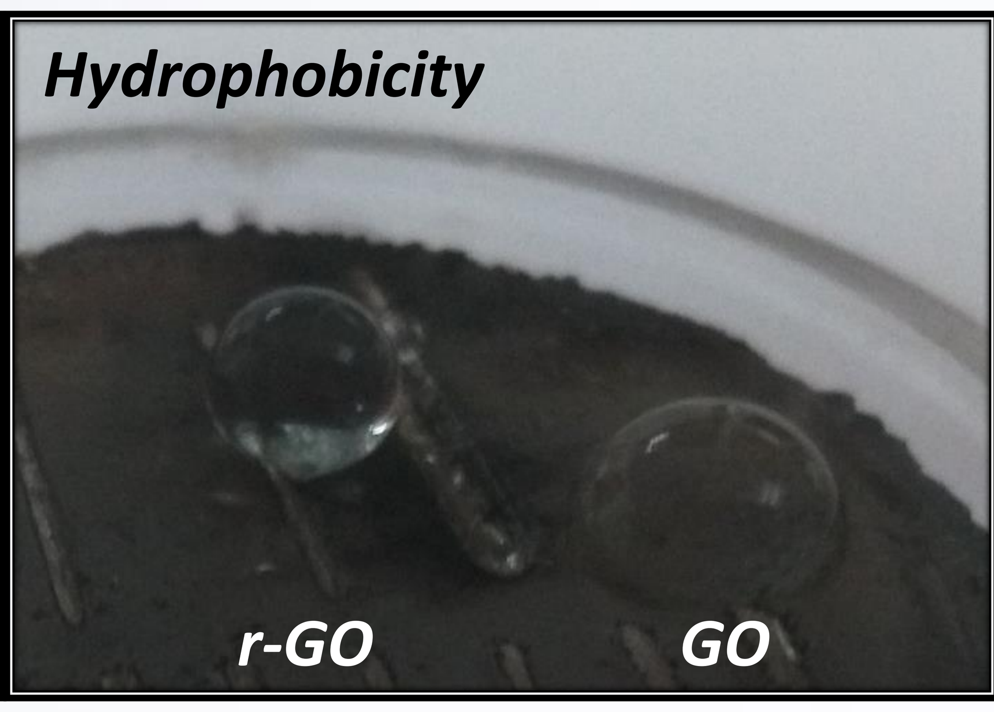


Figure 2.- SEM images of copper grid after immersion in GO solution with sulfuric acid 0.5M.







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