Presentation title: New Insights in the Synthesis of Polyurethane Aerogels

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Presentation type: Oral presentation

Abstract:

A significant advancement has been made with the successful synthesis of waterborne polyurethane (WBPUR) aerogels using freeze-drying as drying procedure. To enhance key properties that are relevant to different applications, particularly density and thermal conductivity, an optimization of the synthesis parameters was undertaken. This optimization process involved the careful adjustment of factors such as the gelation solvent, solids content, chain extender/isocyanate ratio and dispersion mode.

It was observed that the solids content, which ranged from 2-11 wt.%, was identified as the most influential parameter on the density of the aerogels. A clear decrease in density was observed as the solids content decreased. Additionally, it was demonstrated that minimizing the excess of ethylenediamine, which was used as a chain extender, in relation to the isocyanate significantly improved the thermal conductivity of the aerogel. In terms of the chain extender/isocyanate ratio, a compromise situation was found to be crucial, where the initial isocyanate reacts almost completely. Once the different synthesis conditions were optimized, an aerogel with improved properties was synthesized. This was achieved using ethyl acetate as the gelling solvent, a solids content of 3.7 wt.%, an ethylenediamine/isocyanate ratio of 0.20, and sonication as the dispersion mode. The resulting

aerogel attained average values of 0.030 $W \cdot m^{-1} \cdot K^{-1}$ for thermal conductivity and 0.046 $g \cdot cm^{-3}$ for density.

The remarkable lightweight nature of these aerogels, coupled with their insulation and structural capabilities, paves the way for promising opportunities in innovative applications across various sectors. These sectors include, but are not limited to, construction and the automotive industry, where the unique properties of these aerogels could lead to significant advancements in material science and engineering. This research represents a significant step forward in the development and application of aerogels, and it is anticipated that further optimization and exploration of these materials will continue to yield promising results.

Biography :

Óscar del Fresno López - R&D Staff.

Graduated in Chemical Sciences from the University of Castilla-La Mancha (Spain). Subsequently he completed a master's degree in Secondary Education with a specialisation in Physics and Chemistry. In 2022, he worked in the department of analytical chemistry with nanomaterials, he studied nanoclusters in particular. He is currently working as a researcher at the UCLM, specifically at the ITQUIMA (Institute of Chemical and Environmental Technology), within the Department of Chemical Engineering, focusing on the area of materials. His experience has been developed in this field through the BIOMAT project, BIOMAT is a highly innovative 4-year European Project aiming to establish an Open Innovation Test Bed (BIOMAT-TB) for providing services to a wide range of European industries and SMEs in order to accelerate and facilitate the uptake of innovation in nano-enabled bio-based cellular materials. He is currently working on the development of innovative materials to replace conventional insulators, with a particular focus on polyurethane aerogels.