Presentation title: Enhancing flame-retardant properties of polyurethane aerogels doped with silica-based particles

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Abstract

Polyurethane (PUR) aerogels, characterized by their high porosity and extensive surface area, hold significant promise across diverse applications, particularly within the realms of the construction industry and automotive sector. Polyurethane, a polymer of high molecular weight, is synthesized through the reaction between isocyanate and hydroxyl (polyol) functional groups. However, these materials may present certain limitations that can be addressed through the incorporation of doping agents, thereby augmenting their properties. In this study, polyurethane (PUR) aerogels doped with different SiO_2 particles derived from a renewable source were successfully synthesized, and the influence of SiO_2 content on the properties of PUR aerogels was systematically investigated. Specifically, three types of SiO_2-based particles, extracted from rice husk through varying procedures, were assessed to improve the thermal stability of the composites, with a particular emphasis on flame-retardant properties. The influence of the optimal SiO_2 particles, obtained through acid digestion, on the physicochemical characteristics of the synthesized aerogels was comprehensively examined across a content range of 0.5 to 3 wt.%. The results showed that increasing the doping agent content improved the lightness, thermal stability sand flame-retardant properties of the resulting PUR aerogels, with the best performance observed at a 2 wt.% doping level. The results show that increasing the SiO_2 content, especially at a doping level of 2 wt.%, significantly enhances the thermal stability and flame-retardant properties of PUR aerogels. The doped aerogel samples notably improve the fire safety performance of the material, exhibiting up to an eightfold increase in flame retardancy. This research highlights the potential of doped PUR/SiO_2 aerogels in advancing material science and engineering applications.

Biography

Esther holds a degree in Chemistry from the University of Castilla-La Mancha (Spain). Subsequently, she studied a Master's degree in Laboratory Management: Quality, Environment and Safety and another in Advanced Chemistry Research. In 2022, she obtained her PhD degree in Chemistry from the same university thanks to a Predoctoral Training Contract (FPI) funded by the Ministry of

Economy, Industry and Competitiveness. During the doctoral thesis, innovative contributions were made to analytical nanoscience and nanotechnology by designing of new metal- and carbon-based nanomaterials as potential analytical tools for solving problems of food interest. It has also contributed to analytical nanometrology in the environmental field. The development of these analytical methodologies has mainly involved the use of different spectroscopic techniques (surface-enhanced Raman spectroscopy and nanomaterial-assisted fluorescence spectroscopy) and separation techniques. These lines of research have allowed her to participate as a researcher in 5 regional and national projects. The investigation results obtained during her predoctoral career have been published in several prestigious international journals (JRC) and presented at national and international conferences. She is currently a postdoctoral researcher at the Institute of Chemical and Environmental Technology (ITQUIMA), within the Department of Chemical Engineering, specializing in the field of new materials. As a researcher, she studies novel formulations for the design of innovative materials to replace conventional insulators with superior properties and reduced costs. She has a particular focus on polyurethane aerogels through her involvement in the highly innovative European Open Innovation Test Bed (BIOMAT) project.