From Bulk Catalysts to Membranes: Designing a New Route to Achieve Sustainable Fuel Desulfurization

Rui G. Faria[1], Luísa A. Neves[2], Salete S. Balula[1], Luís Cunha-Silva[1]

[1]REQUIMTE/LAQV, Department of Chemistry and Biochemistry, Faculty of Sciences, University of Porto (FCUP), Portugal
[2]LAQV@REQUIMTE, Department of Chemistry, NOVA School of Science and Technology (FCT NOVA), Universidade NOVA de Lisboa, Portugal

E-mail: up201202396@edu.fc.up.pt

A recent report from the U.S. Energy Information Administration claims that fossil fuels will still account for 70% of the world's energy production by 2050 as fuel consumption continues to grow.[1] The combustion of fossil fuels produces several kinds of environmentally deleterious emissions, one of which being the emission of sulfur oxides which generate sulfuric acid, causing acid rain. The crucial desulfurization of road fuels is already assured by hydrodesulfurization (HDS) technologies. However, alternative desulfurization processes need to be developed to treat heavy fuels, opening new routes to avoid wastes in petroleum refineries**.** Oxidative Desulfurization (ODS), has been proven to efficiently remove sulfur from fuels at temperatures and pressures up to 17 times lower than those employed for HDS.[2] The sustainability of this process relies heavily on the investigation into novel catalysts, such as polyoxometalates (POM), metal-organic frameworks (MOF), and their synergistic combination (POM@MOF) which can be efficiently used for ODS.[3] The main hindrance towards taking ODS to an industrial scale has been the powdered nature of the previously mentioned catalysts, which makes them undesirable both from a handling and a recyclability standpoint. This Ph.D. project has been dedicated to the incorporation of bulk active catalysts into polymeric membranes. The novel catalytic membranes increase the stability of the bulk catalysts and at the same time avoid mass loss, increasing their lifetime.

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