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Membrane reactors: From fundamentals to future prospects

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Membrane reactors (MRs) are multifunctional reactors that are characterized by the combination of a (catalytic) reaction with a membrane separation process. The selective transport of the products and/or the reagents through the membrane can increase the yield and/or the selectivity of some processes. As a result, there has been a growing interest in MR technology since the first applications of MR based on polymeric membranes in enzymatic reactions and metallic membranes for high temperature reactions.

When MRs are combined with powerful oxidation processes such as photocatalytic degradation, the resulting configuration is called photocatalytic membrane reactor, PMR (Iglesias et al, 2016). Heterogeneous photocatalysis is an advanced oxidation process based on the use of light and a semiconductor (the photocatalyst) to generate oxidizing/reducing species. It has been extensively studied in the last four decades since Fujishima and Honda reported in 1972 the photocatalytic splitting of water at TiO_2 electrodes (Corredor et al, 2019, 2020). Photocatalysis and membrane separation can be straightforwardly integrated due to the similar conditions at which they usually operate (relatively low temperature and pressure, and low concentration of the chemicals). The membrane acts both as a selective barrier for the contaminants to be degraded, thus maintaining them into the reaction environment, and as the support for the photocatalyst. Most applications have focused on the treatment of polluted waters and wastewaters; oxidant species produced during the photocatalytic process can attack the pollutant and break the molecule in smaller compounds (Domínguez et al, 2014, Gómez et al, 2018). The synthesis of organic substances through photocatalytic oxidation and reduction reactions has been also reported, as PMRs become more sustainable than conventional synthesis methods; Research focused on hydrogen generation deserves a special mention in this field. This lecture will provide an overview of the state-of-the-art of PMRs, starting with the fundamentals, discussing the role of key components, major applications, and future prospects (Gómez-Pastora et al, 2017)

References

Iglesias, O., Rivero, M.J., Urtiaga, A.M., Ortiz, I., Membrane-based photocatalytic systems for process intensification, Chem. Engngn. J. 395, 2016, 136-148

J. Corredor, E. Perez-Peña, M. J. Rivero, I. Ortiz Performance of rGO/TiO2 photocatalytic membranes for hydrogen production; membranes, 10(9)1-13, 2020

J. Corredor, M.J. Rivero, C. Rangel, F. Gloaguen, Inmaculada Ortiz, *Comprehensive review and future perspectives on the photocatalytic hydrogen production*; J. Chem. Technol. and Biotechnol., 2019

S. Domínguez, P. Ribao, M.J. Rivero, I. Ortiz. Influence of Radiation and TiO_2 Concentration on the Hydroxyl Radicals Generation in a Photocatalytic LED Reactor. Application to dodecylbenzenesulfonate degradation. Applied Catalysis B: Environmental 178, 165-169, 2014

Gomez, B., Diban-Ibrahim, N., Rivero Martinez, Rivero M.J., Ribao P. , Ortiz Uribe, I.; Urtiaga , A.M., Photocatalytic degradation and mineralization of perfluorooctanoic acid (PFOA) using a composite TiO2-rGO catalyst, J. of Hazardous Materials, 344 (2018) 950–957

J. Gómez-Pastora, S. Domínguez, E. Bringas, M.J. Rivero, I. Ortiz, D.D. Dionysiou. Review and perspectives on the use of magnetic nanophotocatalysts (MNPCs) in water treatment. Chemical Engineering Journal 310, 407-427, 2017