Functionalised Inorganic Materials and Membranes for Gas and Liquid Processing

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Abstract

Designing functionalised structures has many advantages in separation and catalytic processes. For instance, functionalised silica membranes containing metal oxide or carbon domains can be used in desalination processes at low temperatures, or in hydrogen separation at high temperatures up to 500 ºC. The interfaces of these domains confer functionalities such as improved hydrothermal stability, higher fluxes, or tailored molecular gaps via redox effects. Similarly, perovskites can be doped and surface functionalised with catalysts to deliver high oxygen fluxes from air separation processes. Further, incorporating metal oxides into zeolites or graphene oxides show improved kinetic activity related to the degradation of dyes or other contaminants in wastewaters. Of particular importance, the sacrificial role played by graphene oxide is stabilising the active sites of iron oxides in the heterogeneous Fenton-like reaction is discussed. Finally, building inorganic mixed matrix membranes such as carbon and stainless steel hollow fibres conferred superior mechanical properties whilst separating greenhouse gases.

Joe da Costa is an Australian Research Council (ARC) Future Fellow and a Professor in the School of Chemical Engineering at the University of Queensland, Brisbane Australia. He is also the Director of the FIM^{2}Lab – Functional Interfacial Materials and Membranes Laboratory. Joe has 30 years working experience in industrial, consultancy and academic roles in Brazil, England and Australia. Currently, he leads several research projects in the area of H_2, CO_2, O_2, ethanol separation and desalination using inorganic membranes and membrane reactors, in addition to catalysts for wastewater processing. Joe has over 250 international publications including 13 book chapters, and he is an editorial board member of Nature's Scientific Report open source journal. His work has been cited over 6600 times, and his h-index is 43. He is a Chartered Professional Engineer in the Colleges of Mechanical Engineering and Chemical Engineering of the Institution of Engineers Australia.
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