Graphene Oxide-based membranes for energy and raw materials recovery applications: a scalable journey

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In the past years, Graphene Oxide (GO) has attracted a lot of interest as two-dimensional material with many interesting tunable properties. GO presents itself in the form of stacked graphene sheets with oxygenated functional groups, i.e. epoxy, hydroxy and carbonyl groups. Their presence not only enables the creation of nanochannels in the lamellar structure, but also ensures a negative superficial charge, which enhances its chemical stability and allows for high selective permeability.

GO has shown great potential as membrane material for several different application fields in light of its ion selectivity, together with good mechanical strength, low cost, and simple synthesis. For these reasons, GO membranes can usually be found in various water treatment applications, like water desalination and contaminant removal. But GO membranes have also been functionalized to finely tune their properties, depending on the chosen chemistry and end use application.

We herein propose an excursus about different GO-based membranes and their possible use for raw material recovery and energy applications linked to their scalability. At lab scale, finely tuning the chemistry of the GO flakes dispersion by functionalizing it allows to selectively target and harvest specific ions of interest. GO membranes can also be used for blue energy applications, e.g. as ion exchange membranes for osmotic energy conversion with the incorporation of anions in the lamellar structure. However, by using techniques already known for other carbon materials it is possible to scale up this technology and use GO-based membranes for both energy and environmental sciences applications.