

## Industrial Prototype for Hydrogen Separation and Purification: Graphene Based-Materials Application

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**Abstract :** In order to advance the hydrogen economy, several industrial sectors can potentially benefit from the trillions of stimulus spending for post-coronavirus. Blending hydrogen into natural gas pipeline networks has been proposed as a means of delivering it during the early market development phase, using separation and purification technologies downstream to extract the pure H<sub>2</sub> close to the point of end-use. This first step has been mentioned around the world as an opportunity to use existing infrastructures for immediate decarbonisation pathways. Among current technologies used to extract hydrogen from mixtures in pipelines or liquid carriers, membrane separation can achieve the highest selectivity. The most efficient approach for the separation of H<sub>2</sub> from other substances by membranes is offered from the research of 2D layered materials due to their exceptional physical and chemical properties. Graphene-based membranes, with their distribution of pore sizes in nanometers and angstrom range, have shown fundamental and economic advantages over other materials. Their combination with the structure of ceramic and geopolymeric materials enabled the synthesis of nanocomposites and the fabrication of membranes with long-term stability and robustness in a relevant range of physical and chemical conditions. Versatile separation modules have been developed for hydrogen separation, which adaptability allows their integration in industrial prototypes for applications in heavy transport, steel, and cement production, as well as small installations at end-user stations of pipeline networks. The developed membranes and prototypes are a practical contribution to the technological challenge of supply pure H<sub>2</sub> for the mentioned industries as well as hydrogen energy-based fuel cells.

**Keywords :** graphene nano-composite membranes, hydrogen separation and purification, separation modules, industrial prototype

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