Graphene Structures Engineered for Selective Absorption/Desorption and Permeability Applications

Eden MAMUT
Laurentiu OANCEA, Timur MAMUT, Ana-Maria CARAC, Camelia BACU

Institute for Nanotechnologies and Alternative Energy Sources, "Ovidius" University of Constanta, 124 Mamaia Blv, 900527, Constanta, Romania

emamut@univ-ovidius.ro

Abstract

Graphene is an artificial carbon structure that is well known for its impermeability because the π-orbitals form a dense, delocalized cloud that blocks the gap within its aromatic rings. As a consequence, even the smallest molecules like hydrogen and helium are not allowed to pass through, even at very high pressures difference.
Theoretical predictions suggest that artificial pores in graphene can facilitate its permeability and permeation-selectivity and there is a significant literature that is analysing and predicting different types of properties and possible applications. [1], [2].
The paper is synthesizing the research activities that have been grouped on the following directions:
- Modeling and simulation of graphene structures and the related transport phenomena which is based on fractal theory that allows the possibility to couple the structural models of graphene layers and the transport processes at molecular and continuum scales.
- Controlled synthesis of GML and GFL for obtaining large samples to be used further in functionalization of graphene for selective permeation properties. The solution for the development of large samples of graphene sheets has been studied by the INSAE research team in the last 10 years and it has been conceived an innovative approach derived from metallurgical processes, consisting in the dissociation of CO2 in eutectic solutions of liquid metal compounds. The main focus has been concentrated to facilitate the decrease of the temperature of the process and the development of a better quality of graphene layers.
- The functionalization of the graphene structures aiming to use a combination of different methods as UV and LASER ablation and chemical treatment, in order to develop a large variety of permeation structures from graphene quantum dots consisting of graphene islands connected to source and drain contacts, structural pores for selective permeation and molecular ducts for reverse osmosis (RO) or forward osmosis (FO). The integrated approach was expected to facilitate the cross fertilization of different techniques in order to generate new types of structures that will be better suited for coupled transport phenomena. [3]

References

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