Materiali avanzati
Advanced Materials

DII research group
Polymer Engineering
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This study was carried out in collaboration with:
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This project started thanks to the cooperation
with the research group of
Prof. Seeram Ramakrisnha at the Centre of
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Main research topics:

• Physical and chemical recycling of
  polymeric materials

• Thermal stability and fire behavior of
  polymeric materials

• Polymeric nanocomposites

• Polymer and biopolymer processing

• Nanostructured membranes based on nanofibers
  (electrospinning and electrospraying)

Graphene/TiO$_2$ based catalysts on nanostructured membranes as advanced solutions for VOCs control

Photocatalytic oxidation processes (PCO) represent more and more promising technologies for air purification and the development of new solutions in pollution sensing and prevention by using adequate nanostructures with unique properties has gained more interest in the scientific community. The present work is meant to show the production, characterization and the photocatalytic performance of nanostructured membranes based on electrospun polyacrylonirile (PAN) scaffolds and graphene/titania based catalysts. Three different systems of photocatalyst were chosen (Fig.1) in order to compare their photocatalytic properties: pristine TiO$_2$, TiO$_2$ plus a few-layers graphene (Fig.2) and TiO$_2$/reduced-graphene composite obtained by hydrothermal method from graphene oxide. Results of the photocatalytic performance on methanol gas-phase degradation, revealed a higher reaction rate of the graphene based photocatalysts wherein an effective charge transfer, enhanced by graphene, has been supposed to reduce the charge recombination increasing the photocatalytic activity of TiO$_2$ nanoparticles. Moreover, it has been found that the performance of the nanostructured membranes can be restored by stripping with an inert gas several times and this property makes them a good candidate as active filter media.
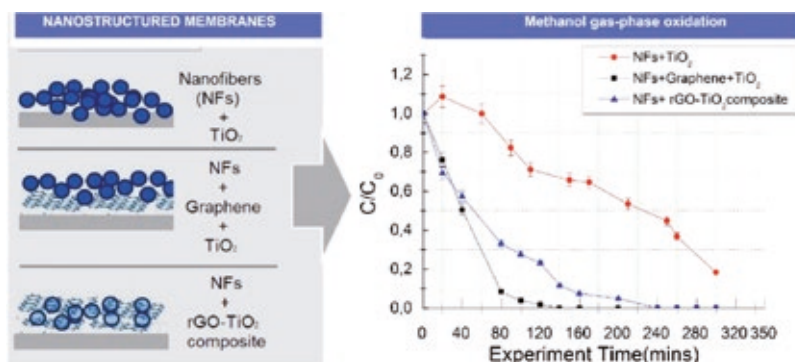

Fig.1. Left: Outline of the membrane production steps: Type A, PAN nanofibers and pristine TiO$_2$ nanoparticles; Type B, multilayered PAN nanofibers, graphene layer and TiO$_2$ nanoparticles; Type C, PAN nanofibers and TiO$_2$/graphene composite; Right: Plot of the ratio C/C$_0$ vs time for different nanostructured membranes
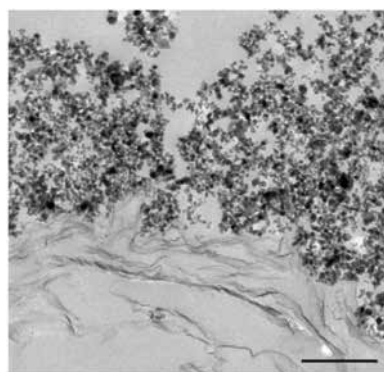

*Fig. 2.
TEM micrograph of the membrane based on electrospun nanofibers, plus graphene layer and TiO$_2$ layer (bar scale 500 nm)*