Engineered graphene composites for enhanced drinking water purification technologies

Manuela Melucci
Laura Favaretto,[a] Sara Khaliha, [a] Massimo Zambianchi, [a] Antonio Bianchi, [a] Sebastiano Mantovani, [a] Alessandro Kovtun, [a] Barbara Casentini, [b] Sara Valsecchi, [b] Stefano Polesello, [b] Vincenzo Palermo [a]
[a] *Institute of Organic Synthesis and Photoreactivity (CNR-ISOF), Via Piero Gobetti 101, 40129, Bologna, Italy,*
[b] *Water Research Institute (CNR-IRSA), Via Salaria Km 29,300 C.P, 10- 00015, Monterotondo Stazione, RM, Italy and Via del Mulino, 20861 Brugherio (MB), Italy*
manuela.melucci@isof.cnr.it

The purification of water from microcontaminants is a major urgent problem worldwide. Much of our tap water comes from rivers, streams, lakes and groundwater. These water resources are increasingly contaminated by discharges of chemicals from industries and urban areas, most of them not fully removed by standard water treatment. Traces of prescription medications, antimicrobial chemicals, pesticides, cosmetics, with suspicious or even proved toxic effects have been found in several EU water bodies. [1] In answer to such crucial issues, the new European Drinking Water Directive EU 2020/2184 [2] includes new limits and contaminants and a water safety plan approach, calling for the urgent development of low cost and efficient water purification technologies. In the last years, Graphene oxide (GO) has shown great potential as adsorbent for water purification from organic microcontaminants, metal ions and heavy metals. [3] The high surface area and the presence of oxygen surface functionalities makes GO particularly suitable for the adsorption of contaminant including those of emerging concern (EC). [4]

Here, we report on GO-polymer based filters, both membranes and sorbent types, for Point-of-Use (POU) drinking water purification systems. We describe the preparation of new polysulfone/polyethersulfone (PSU/PES)-graphene oxide (GO) composites with tuneable surface properties though tailored GO chemical functionalization. We demonstrate the suitability of GO enhanced membranes and sorbents for the fabrication of filters for the removal of emerging contaminants from tap water.

Stable fixation of GO on commercial PSU and PES membranes and granular sorbents was achieved by a water-based procedure under mild thermal activation. Selectivity and filtration efficiency on selected contaminants including very persistent ones such as perfluorinated alkylate substances (PFAS), arsenic and antibiotic, as well as filter working mechanism will be discussed. Particular focus on the relationships between graphene functionalization /surface charge/amount, type of polymeric substrate, with the removal performance will be given.

Figure 1: Tap water purification by graphene composite-based POU filters

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