Challenges and opportunities for graphene composites in water treatment

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Abstract

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, also called emerging concern contaminants (EC), 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 contaminants including ECs from drinking water. [4]

Here, we report on GO-polymer based materials and filters 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 will discuss on the i) selectivity and filtration efficiency of the new GO composites on selected contaminants including very persistent ones such as perfluorinated alkylate substances (PFAS), arsenic and antibiotic, ii) filter working mechanism and iii) relationships between graphene functionalization /surface charge/amount, type of polymeric substrate, with the removal performance.

Biography

[1] S. D. Richardson, S. Y. Kimura, Water Analysis: Emerging Contaminants and Current Issues. Analytical Chemistry 2020, 92 (1), 473-505.

[2] https://eur-lex.europa.eu/eli/dir/2020/2184/oj

[3] N. Yousefi, X. Lu, M. Elimelech, N. Tufenkji Nature Nanotechn. 2019, 14, 107.

[4] a) A. Kovtun, M. Zambianchi, C. Bettini et al, Nanoscale, 2019, 11, 22780. b) A. Kovtun, A. Bianchi, M. Zambianchi, C. Bettini et al Faraday Discussions *Faraday Discussions* **2021,** *227* (0), 274-290, c) S. Mantovani, S. Khaliha, L. Favaretto, C. Bettini, A. Bianchi, A. Kovtun, M. Zambianchi, M. Gazzano, B. Casentini, V. Palermo M. Melucci Chem. Commun., 2021, 57, 3765