Water treatments and nanotechnologies for water remediation

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A wide variety of factors act as driving forces for the application of post-treatment technologies in wastewater treatment plants (WWTPs). Increasing demand of fresh water due to the growth of population and the high consumption in agricultural and industrial sectors has promoted the wastewater reuse as a new challenge in water field. Additionally, the risk associated to the presence of compounds of emerging concern (CECs), such as pharmaceutical and personal care products, in secondary effluents due to their incomplete removal during conventional wastewater treatment is of public concern taking into account the dangerous effects already demonstrated through different studies. Among polishing technologies more applied in WWTPs to obtain effluents exhibiting the necessary requirements for their posterior destination (either discharge or reuse) are the disinfection technologies. Although different disinfection techniques exist to treat the wastewater, UV treatment is one of the most common technologies applied worldwide in WWTPs due to the competitive advantages that exhibit in comparison to others, such as ozonation or chlorination.
A promising solution to increase the CECs removal efficiency during UV treatment is the combination with catalysts. Heterogeneous photocatalysis has become relevant in the last years since chemicals are not necessary for the oxidation processes, being titanium dioxide (TiO_2) the catalyst that is receiving more attention due to the nonspecific nature of the reactive species produced under UV irradiation. During the photocatalytic treatment, TiO_2 is activated by the UV light generating powerful oxidizing species (e.g. hydroxyl radicals (·OH)) which can transform the CECs, even achieving the mineralization of some compounds. However, the application of suspended TiO_2 is limited at full-scale since the small size of the catalyst complicates its recovery at the end of the treatment, reducing its potential reuse and compromising the quality of treated effluent. To overcome this drawback, the immobilization of TiO_2 nano-size particles on different materials is of great interest.