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A magnetic pH-induced textile fabric with switchable wettability for intelligent oil/water separation

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Abstract

Wastewater discharged in human daily life, and oil spill accidents occurred frequently. The novel interface materials used for controllable oil/water separation have gained more and more attention. In this work, a facile, environmentally friendly approach is presented to fabricate a magnetic textile fabric with pH-controllable wettability between superhydrophobicty and superhydrophilicity. We prepared this magnetic textile fabric by immersing in lauric acid (LA)-TiO_2 composites and Fe_3O_4 nanoparticles. The resulted pH-conrtollable textile fabric possessed selective separation performance for oil/water mixtures with efficiency higher than 99% and high flux for oil (11000 L h^{-1} m^{-2}). Moreover, the magnetic material is recyclable, the detailed experiments were conducted in this work for 25 cycles of oil/water mixture separation remaining unchangeable separation efficiency (>98%). For neutral water (e.g., at pH 7), the novel Fe_3O_4/LA-TiO_2 textile fabric demonstrated superhydrophobicity/ superoleophilicity in air. For alkaline water (e.g., at pH 12), the textile fabric showed superhydrophilicity and underwater superoleophobicity. The Fe_3O_4/LA-TiO_2 textile fabric could separate a series of light or heavy oil/water mixtures with high separation efficiency up to 99.1%, high oil flux of 7400–11000 L h^{-1} m^{-2} and water flux of 5300–5700 L h^{-1} m^{-2}. In addition, thermal stability (~180 ^{0}C) and long exposure to ultraviolet rays showed that the textile fabric was stable in harsh environment. The textile fabric can be easily removed through a magnet due to its magnetic properties. It can be concluded from the results that Fe_3O_4/LA-TiO_2 textile fabric is a good candidate for practical applications, such as water restoration and oil-spill treatment.

Keywords: oil/water separation; pH-controllable; magnetic; textile fabric; switchable wettability