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Modified metal mesh with bipolar wettability for rapid and gravity-driven oil-water separation and oil collection

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Abstract: Oil contamination from oilfield geothermal water severely restricts the efficient utilization of geothermal energy. Oil-water separation pretreatment via removing oil from water may provide a kind of possibility to mitigate the oil pollution problem. Stainless steel filtration mesh with bipolar wettability was successfully fabricated to attempt the gravity-driven separation of various oil-water mixtures. The highly hydrophilic mesh was prepared by liquid phase deposition of TiO_2, and the hydrophobic mesh was realized via the subsequent modification of fluorosilane on highly hydrophilic mesh deposited by TiO_2. Only with relatively small pore size, the highly hydrophilic mesh and the hydrophobic mesh were applicable for separating oil-water mixtures. Besides, microscopic morphologies, surface chemical compositions, contact angles, water wetting behaviors, water-holding capacities, abrasion test and oil collection were also investigated. In general, the modified mesh with bipolar wettability presents gravity-driven oil-water separation for various oil-water mixtures, which may have potential industry application value such as the pretreatment of oilfield geothermal water.

Key Words: bipolar wettability; gravity-driven oil-water separation; underwater oleophobicity; underwater oleophilicity.

1. Introduction

Compared with solar energy and wind energy, geothermal energy acting as a kind of renewable green energy resource has the prominent advantages of stability, wide distribution, huge storage and low cost [1-3]. The pre-existing infrastructure and technology at oilfield provide numerous conveniences for oilfield geothermal energy development [4]. As an example of geothermal energy utilization in oilfield, the geothermal water in oilfield can be used for heating through heat exchanger [5]. However, the crude oil adhered on heat transfer surface will obviously decrease the heat transfer coefficient of heat exchanger. The crude oil existing in the oilfield geothermal water seriously affects