松　基超疏水涂层制备及其油水分离应用

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【目的】海上溢油、溢油污染频发，工业生产排放油水混合物增多，不仅对生态环境和社会经济造成严重影响，也严重威胁人类健康。这些肆意排放的油水混合物污染了水资源，同时也侵占了其他生态资源，使绿色家园面临风险。随着各种有机溶液的混合，油水混合物的分离变得越来越困难。目前，氟化物和长链脂肪族化合物是制备超疏水涂料中最常用的低表面能化学物质，但相关的环境风险和不稳定性限制了它们在油水分离中的潜在应用。本研究描述了一种基于松香酸和 SiO_2 改性棉织物的超疏水涂层来克服这一挑战。【方法】通过喷雾浸渍和紫外光辅助点击反应，将巯基改性松香酸 (RA)、八乙烯基 POSS 和二氧化硅接枝到棉织物表面，获得具有荷叶状粗糙表面和低表面能的 RA-SiO_2 超疏水涂层。八乙烯基 POSS 能使 SiO_2 均匀分散在超疏水涂层中，还能有效降低材料表面的表面能。在紫外辅助下制备了 RA-SiO_2 超疏水涂层。RA-SiO_2 超疏水涂层具有优异的防污性能、自清洁能力、耐久性和化学稳定性。【结果】RA-SiO_2 超疏水涂层可有效分离各种油水混合物，即使经过反复循环试验，仍保持较强的油水分离效率和渗透通量。此外，RA-SiO_2 超疏水涂层可有效分离 W/O 乳剂和 O/W 乳剂，并描述了油水乳剂的分离机理。分离效果重复 10 次后，效率为 96.3%，渗透通量为 6110.84 ($L \cdot m^{-2} \cdot h^{-1}$)。【结论】RA-SiO2 超疏水涂层具有良好的自清洁能力，能吸附各种轻重油，实现油水混合物的高效分离。无氟环保的基于松香酸的低成本超疏水涂层由于其优异的分离性能，有望在油水分离应用中发挥巨大的潜力。

关键词：松香；棉织物；超疏水涂层；油水分离；无氟

Abstract: Rosin acid and SiO2 modified cotton fabric to prepare fluorine-free durable superhydrophobic coating for oil-water separation

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【Objective】The frequent occurrence of oil spills at sea, oil pollution spills, and the increase of oil-water mixtures discharged from industrial production have not only caused serious impacts on the ecological environment and

social economy, but also seriously threatened human health. These recklessly discharged oil-water mixtures polluted water resources while also encroaching on other ecological resources, putting the green home at risk. The separation of oil-water mixtures becomes more and more difficult with the mixing of various organic solutions. Currently, fluorides and long-chain aliphatic compounds are the most frequent low surface energy chemicals utilized in the preparation of superhydrophobic coatings, but associated environmental risks and instability restrict their potential application in oil-water separation. This research described a superhydrophobic coating based on rosin acid and SiO_2 modified cotton fabric to overcome this challenge【Method】By means of spray impregnation and UV-assisted click reaction, sulfhydryl modified rosin acid (RA), Octavinyl-POSS, and SiO2 were grafted onto the surface of cotton fabric to obtain RA-SiO2 superhydrophobic coating with rough surfaces such as lotus leaf and low surface energy. Octenyl-POSS can make SiO2 disperse evenly in the superhydrophobic coating, and it can also

effectively reduce the surface energy of the material surface. RA-SiO2 superhydrophobic coating was prepared under UV-assisted irradiation. The RA-SiO2 superhydrophobic coating showed excellent antifouling performance, self-cleaning ability, and durability and chemical stability【Result】All kinds of oil-water mixtures can be effectively separated by RA-SiO2 superhydrophobic coating, even after repeated cycle tests, it still maintained strong oil-water separation efficiency and permeation flux. In addition, W/O emulsions and O/W emulsions can be effectively separated by RA-SiO2 superhydrophobic coating, and the oil-water emulsion separation mechanism was described. The separation efficiency was 96.3% and the permeate flux was 6110.84 ($L \cdot m^{-2} \cdot h^{-1}$) after 10 repetitions【Conclusion】The RA-SiO2 superhydrophobic coating had favorable self-cleaning ability, and also adsorbed various light and heavy oils to achieve efficient separation of oil-water mixtures. The fluorine-free and environmentally friendly low-cost superhydrophobic coating based on rosin acid is expected to play a significant potential in oil-water separation applications due to its excellent separation performance.

Key words: Rosin acid; Cotton fabric; Superhydrophobic coating; Oil-water separation; Fluorine-free