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Interaction between membrane and organic compounds studied by atomic force microscopy with a tip modification

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Abstract:

Membrane fouling by organic, inorganic and biological materials is a significant cause of the increased operational costs in the membrane separation processes such as reverse osmosis, nanofiltration, ultrafiltration and microfiltration. To better understand the fouling mechanism and increase the membrane performance via optimizing membrane structure, elucidation of the physicochemical interactions between membranes and foulants is essential. Atomic force microscopy (AFM) has been proved to be a powerful method to qualitatively characterize the interaction force between the tip and the substrate. In this paper, the AFM tips were modified to bear five representative organic end-groups: benzyl, hexyl, propionic acid, ethylamine hydrochloride, sodium propyl sulfonate, which are commonly found in organic foulants. The adhesion force between the modified AFM tip and the reverse osmosis membrane was measured carefully to understand the potential fouling tendency of each category function group on the membrane. The results showed the average interaction force between the tip modified by -$(CH_2)_3$-SO_3Na group and membrane is 13.80 nN, which is as twice as the force between membrane and the unmodified tip. The results also showed that the tips modified by -$(CH_2)_2$-COOH group and -$(CH_2)_3$-SO_3Na group, have stronger interaction force with the membrane surface than the tips modified by three other end-groups, which indicated