Electronical Supporting Information

Kevlar Fiber Reinforced Multifunctional Superhydrophobic Paper for Oil-Water Separation and Liquid Transportation

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Video description:

Anti-flouring and self-cleaning tests of SH paper including milk and HCl solution dyed with methyl orange. (**Movie S1**)

Fire-resistant tests of SH paper and ordinary commercial paper. (**Movie S2**)

The as-prepared SH paper used for 1,2-dichloroethane/water separation. (**Movie S3**)

The sliding process of water droplet on the SLIPS recorded by contact angle tester, and the sliding process of copper chloride and glycol dyed with sultan Ⅳ on SLIPS. (**Movie S4**)

Fig. S1. Physical map of flocculent HAPNWs dispersed in ethanol.

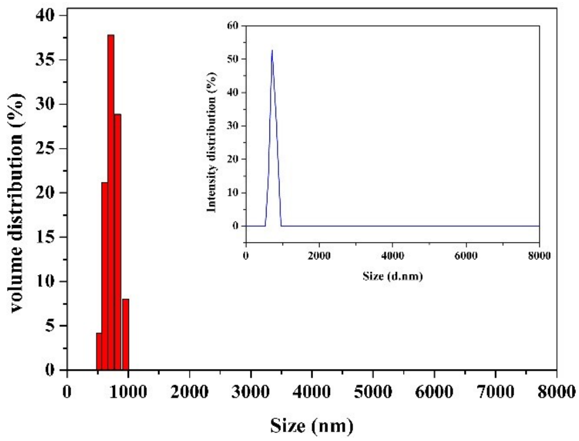

Fig. S2. Size distribution of the synthetic TiO2 nanoparticles.

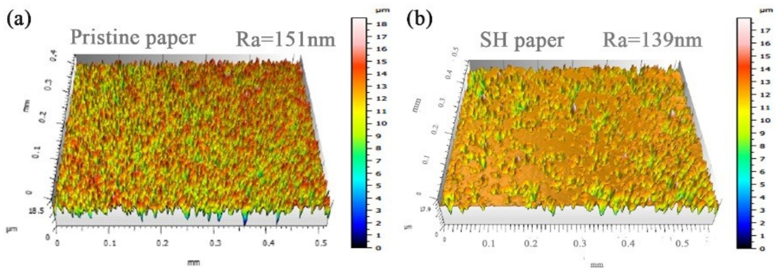

Fig. S3 three-dimensional surface morphology images of (a) pristine paper and (b) SH paper.

In order to characterize the smoothness of the paper, three-dimensional surface morphology and corresponding surface roughness profile of the pristine paper and SH paper are measured by 3D Non-contact Profiler. As shown in Fig. S3 , the roughness of the pristine paper and SH paper is 151 and 139nm, respectively. Compared with the pristine paper, the roughness of the SH paper reduces slightly and the surface smoothness is increased, mainly because the STA covers the rough structure on the surface.

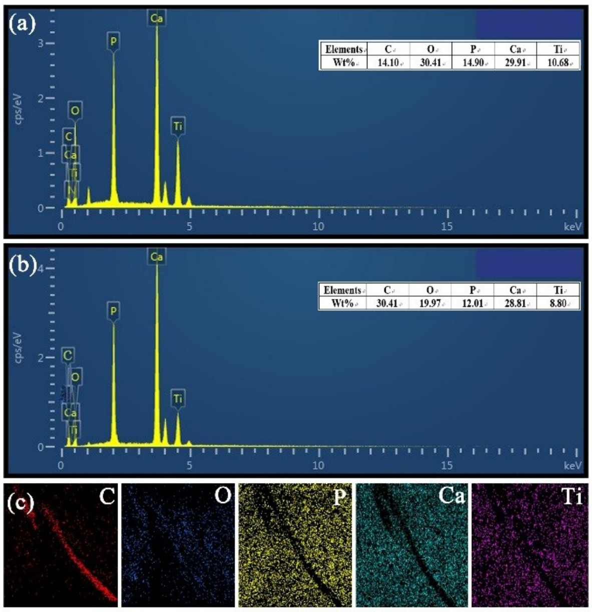

Fig. S4. (a)EDS spectra of pristine paper and (b) EDS spectra of SH paper; (c) FESEM-EDS images of SH paper.

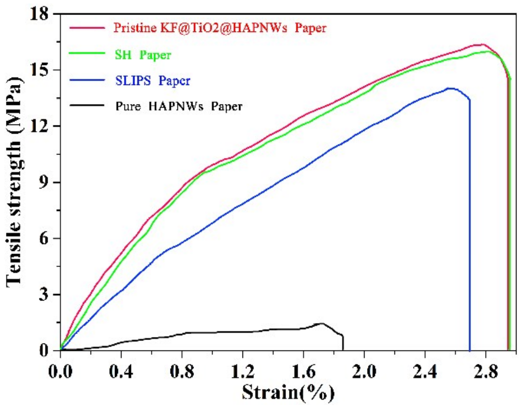

Fig. S5 the tensile stress-strain curves of the pristine KF@TiO2@HAPNWs paper, SH paper, SLIPS paper and pure HAPNWs paper.

The tensile stress−strain curves of the pristine KF@TiO2@HAPNWs paper, SH paper, SLIPS paper and pure HAPNWs paper are shown in Fig. S. It is found that the tensile strength and Young's modules of the pure HAPNWs paper are circulated to be 1.32Mpa and 0.13Gpa, respectively. In comparison, the pristine KF@TiO2@HAPNWs paper and SH paper containing of KF reinforcement exhibit the enhanced mechanical property. The tensile strength and Young's modules of pristine KF@TiO2@HAPNWs paper and SH paper are circulated to be 16.4MPa and 3.9GPa, 16.2MPa and 3.6GPa, respectively, manifesting the modifier (STA) do not have much effect on paper's mechanical property. The boosted tensile strength of pristine KF@TiO2@HAPNWs paper and SH paper may be on account of the strong interfacial adhesion and interactions among the HAPNWs driven by the van der Waals forces. Moreover, mechanical locking between the KF coated by HAPNWs can prevent nanowire sliding between KF, which is also to be a factor. In contrast to the pristine KF@TiO2@HAPNWs paper and SH paper, the mechanical property of paper decreases slightly, the tensile strength and Young's modules of which are calculated to be 13.6MPa and 4.1GPa. we speculate that this is mainly because the lubricant oil reduces the interaction force between HAPNWs and KF. In addition, the infused oil can also plays a lubricating role to reduce the frictional force when the fiber slide. To be sure, the doped KF can greatly improve the mechanical performance of the paper.

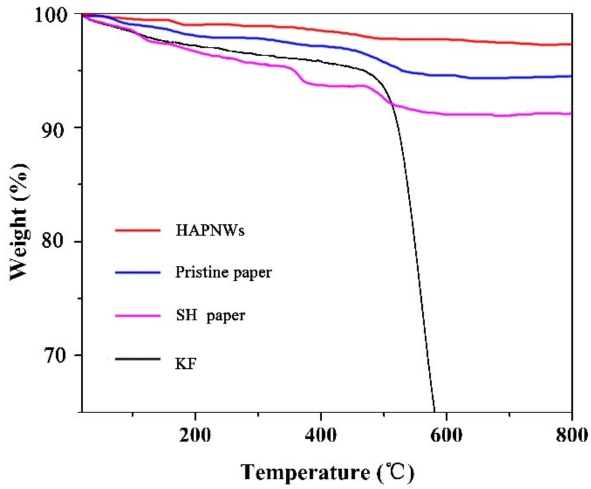

Fig. S6. TGA curves of KF, HAPNWs, Pristine paper and SH paper.

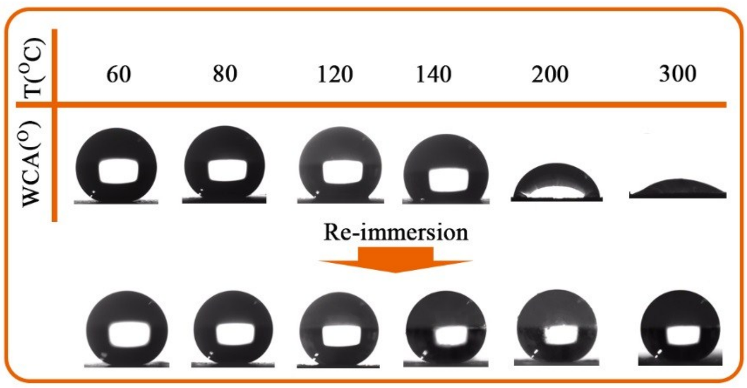

Fig. S7 the change of water contact angle (WCA) after the SH paper treated with various temperature for 2 hours, and the corresponding WCA after re-immersion process.

The thermal stability of superhydrophobicity of the as-prepared paper was measured by heating the paper at various temperatures (60, 80, 120, 140, 200, 300℃) for 2 hours. As exhibited in Fig. S7, water droplet can still maintain a spherical shape on the surface after the SH paper is treated with 60, 80 and 120℃ for 2 hours. when the temperature rises to 200℃, the anti-wetting property of the surface has decreased significantly. When the temperature rises to 300℃, the surface changes from superhydrophobic to superhydrophilic. It is mainly because high temperature volatilizes the modifier and increases surface energy of the paper. In order to detect the repairability of surface's anti-wetting property, we re-immersed each temperature-treated surface into the STA solution. The results showed that water contact angle on all surfaces could also reach 150° after drying at 60℃. That was, it had not great influences on the surface wettability when the temperature was less than 120℃, and the wettability of the surface was decreased at high temperatures. Fortunately, the anti-wetting performance of the paper could be restored by coating the surface with a new modifier layer.

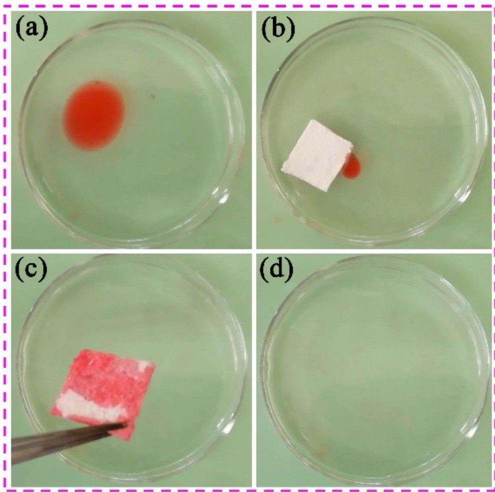

Fig. S8. Oil/water separation. (a) Cyclohexane (dyed with sultan Ⅳ) is dropped onto the water surface in a culture dish and it can float on the water surface; (b) a piece of SH paper is brought into contact with the cyclohexane and the oil can be adsorbed by SH paper; (c) the appearance of SH paper after oil separation; (d) Cyclohexane is completely removed from the water surface, and oil/water separation is achieved.

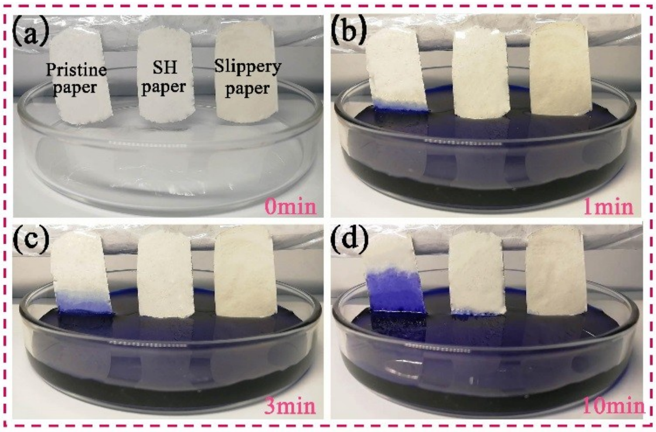

Fig. S9. The time-sequence photographs of the pristine paper, SH paper and slippery paper immersed into blue-dyed water. As time goes on, the water in the petri dish moved continuously along the fiber orientation of the pristine paper due to the capillary effect. owing to the hydrophobicity of the surface of SH paper and slippery paper, the water cannot penetrate into the surface structure and the surfaces always keep white color.