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Wettability Alteration from Superhydrophobic to Superhydrophilic via Synthesized Stable Nano-Coating

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Abstract

In this study, synthesized $\text{TiO}_2/\text{SiO}_2$ hybrid nanoparticles were used to fabrication of hydrophilic coating with high stability on superhydrophobic surface of carbonate rock. For this purpose, n-heptane droplet contact angle in water medium was measured on the rock surface before and after treatment. The $\text{TiO}_2/\text{SiO}_2$ nanoparticles were synthesized by modified sol-gel method. This method is based on increasing functional groups on the surface of the TiO_2 nanoparticles to produce high hydrophilic nanoparticles. The synthesized nanoparticles were characterized by Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD) analyses. The chemical composition and morphology of untreated and treated rock surface were determined using XRD and SEM analyses. It was observed that the n-heptane droplet was instantly spread on the untreated rock and its contact angle in water medium was 0° , in the other hand the water contact angle in n-heptane medium was 168° , so the un-coated rock was superhydrophobic. After adsorption of nanoparticles on the rock surface, the n-heptane droplet contact angle changed to 165° and the water contact angle changed to 0° so the coated rocks were superhydrophilic. The fabricated nano-coatings exhibited high thermal stability and moderate mechanical stability; also the coated surfaces had high stability in contact with salt solution, the results were encouraging.

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