

Adsorption behaviour of silica nanofluid on coal and the injectivity enhancement mechanism

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Introduction

In this work, water-based silica nanofluid, which has stable performance and is environmentally friendly, is selected as a wetting agent for coal seam water injection. Several variables are set to investigate the whole process of “particle adsorption-modification effect-injection enhancement mechanism” of nanofluid wetting agent, aiming to reveal the adsorption behaviour of silica nanofluid on coal and its mechanism of injectivity enhancement through experiments

Experiment Methodology

- 1. Characterization of nanofluid surface deposition on coal:** Real-time monitoring of the morphological evolution characteristics are conducted and deposition images of nanofluid droplets on coal surface are obtained
- 2. Wettability and water adsorption evolution of modified coal:** Variations in the wettability and water adsorption are obtained through contact angles and weight changes
- 3. Impact of cyclic water injection on modified coal wettability:** Effect of cyclic water injection on wettability with different nanofluid treatment times is investigated through contact angles

Samples and nanofluids for experiments

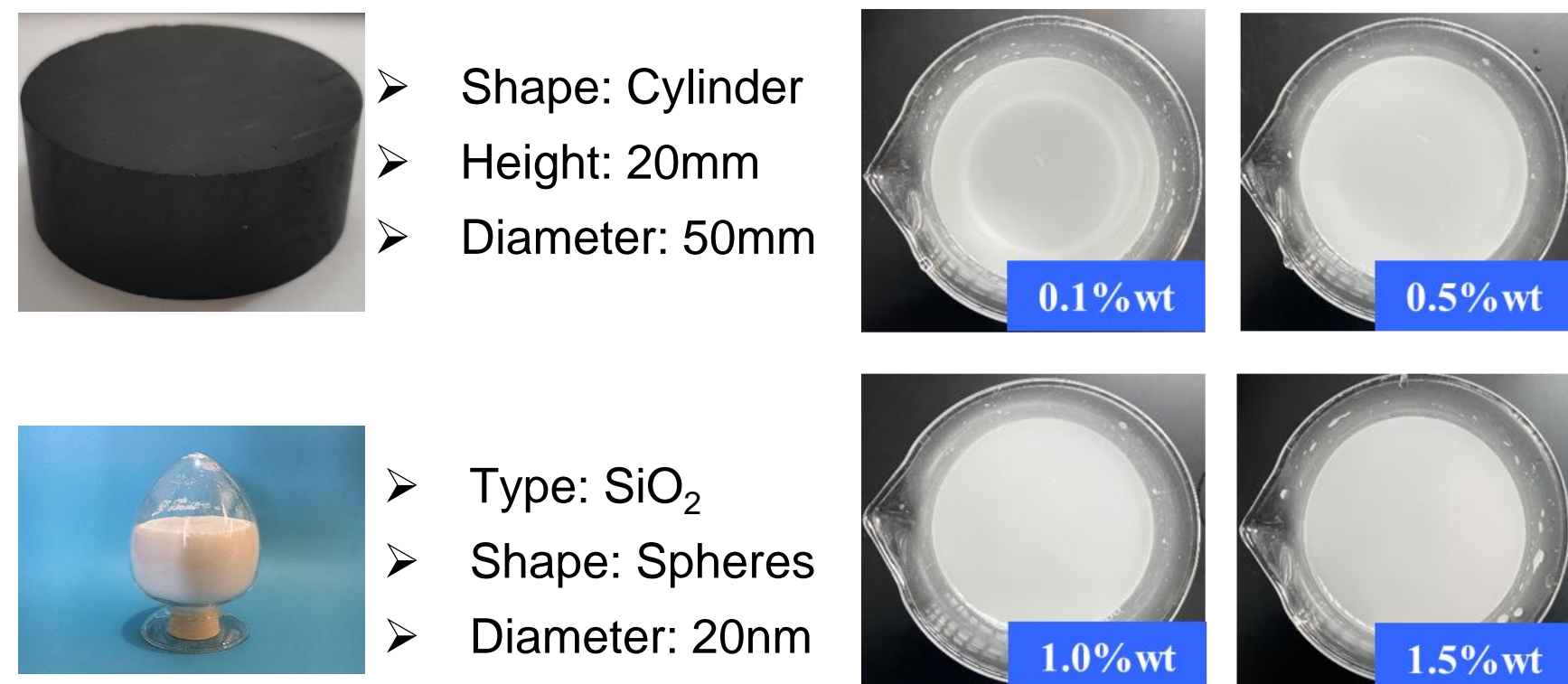
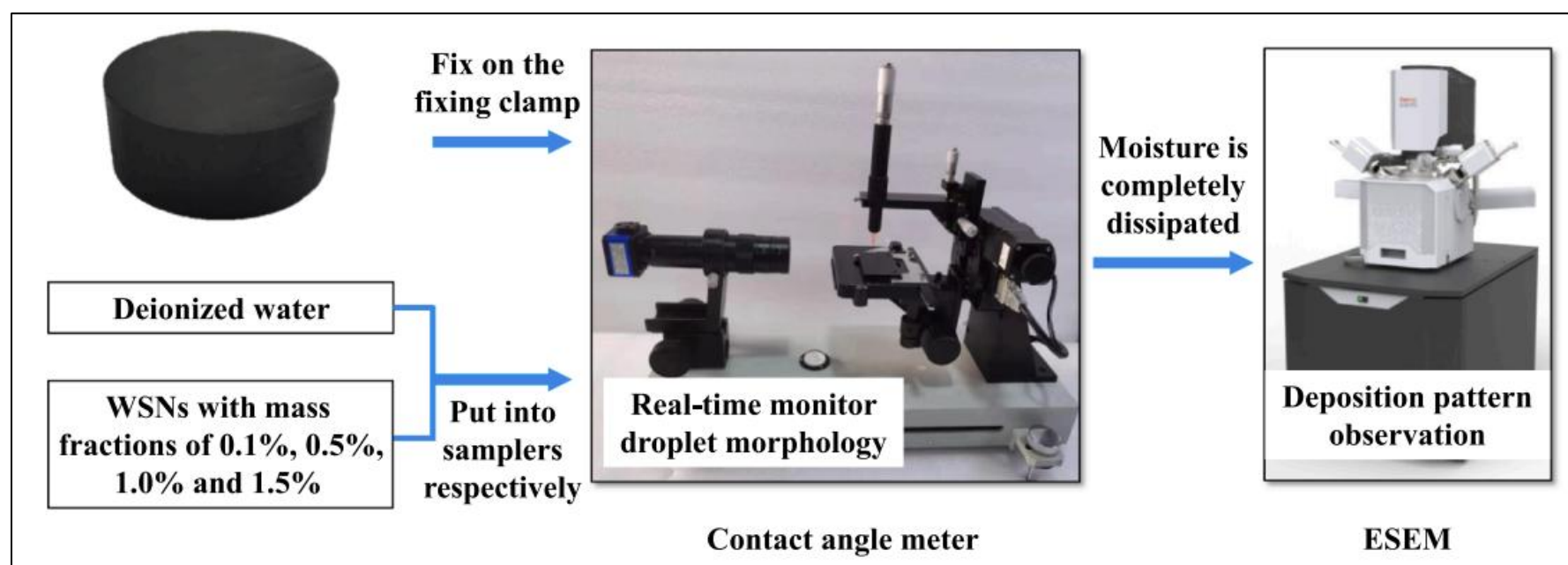
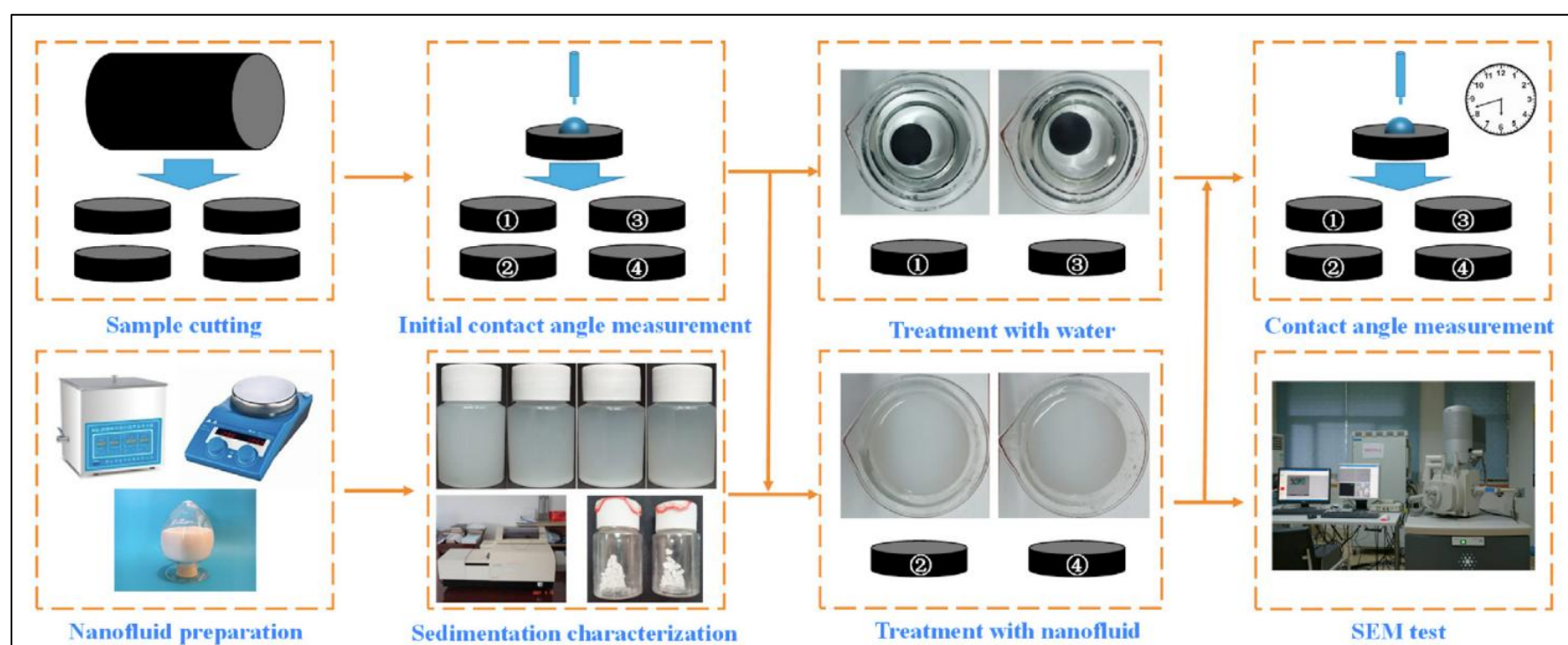


Figure 1: The coal sample and 4 different concentrations silica nanofluid

Experimental apparatus



(a) Characterization of nanofluid surface deposition on coal



(b) Wettability and water adsorption evolution of modified coal

Figure 2: Schematic of experimental apparatus



(c) Impact of cyclic water injection on modified coal wettability

Figure 2 (cont'd): Schematic of experimental apparatus

Experiment Results

Characterization of nanofluid surface deposition

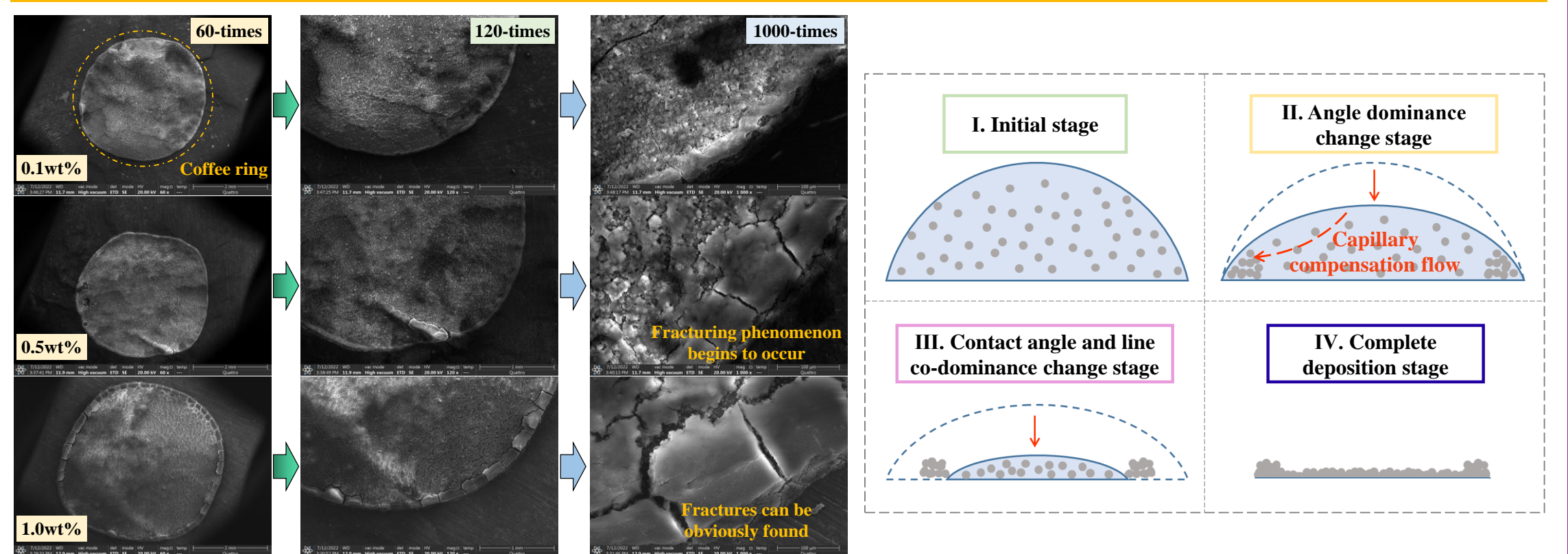


Figure 3: Deposition patterns of nanofluid droplets and four stages deposition process

Wettability and water adsorption evolution

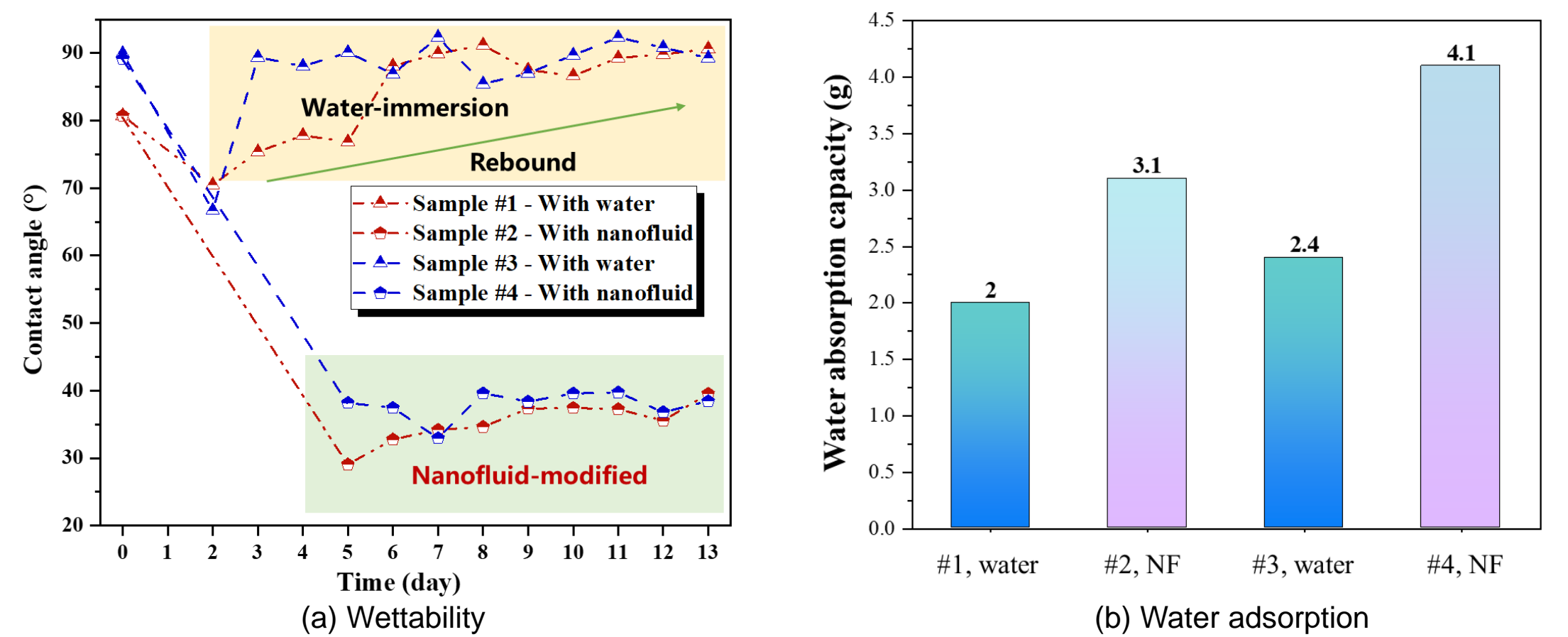


Figure 4: Contact angle and water adsorption changes in nanofluid-modified coal samples

Impact of cyclic water injection on modified coal wettability

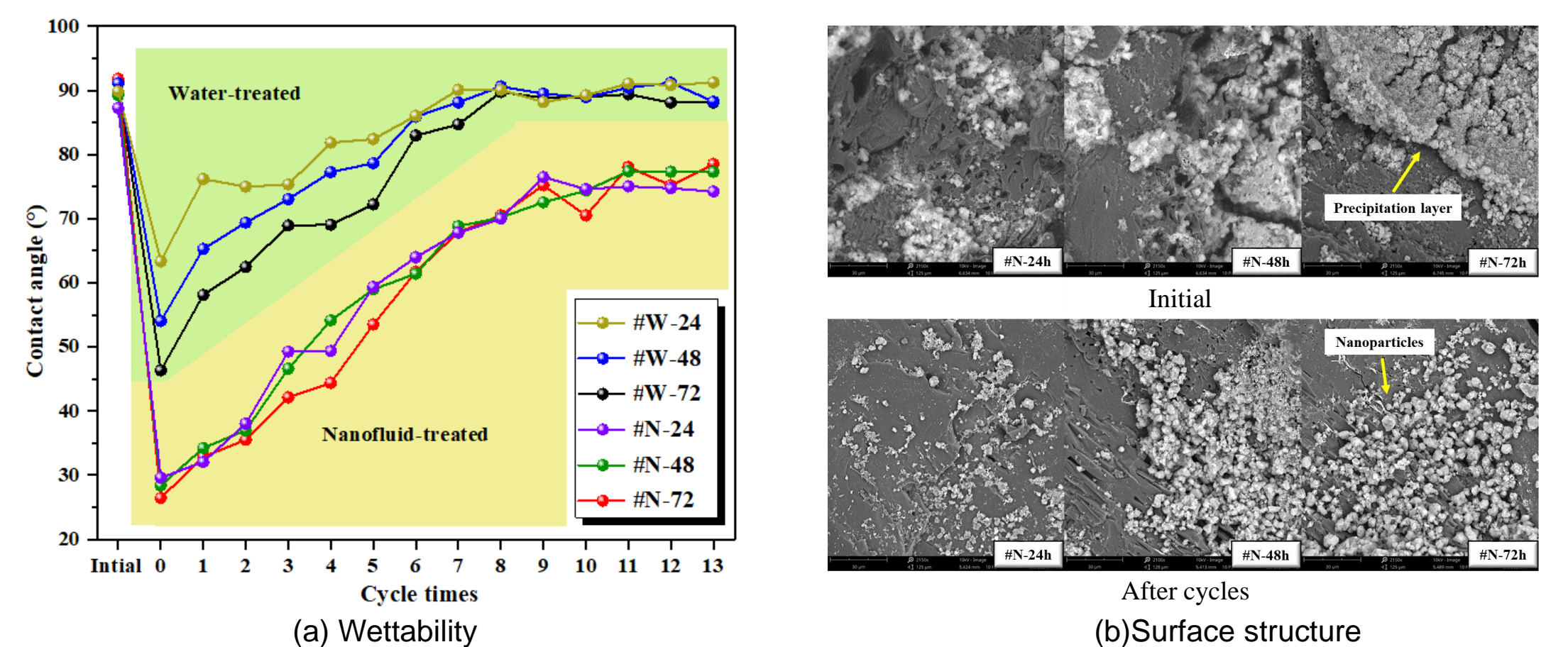


Figure 5: Wettability and structure changes on coal surface with water immersion cycles

Conclusions

Nanofluid-modified coal adsorbed the nano-silica dioxide particles during the modification treatment, so that the Si-OH structure was generated from particles as the active site, which enhanced the hydrophilicity of the nanofluid-modified coal sample and increased the capillary force on water in the microfracture. In addition, adsorption quantity of nano-particles is a key factor in changing coal wettability.