



Contribution ID: 508

Type: Oral Presentation

Probing into nanoparticles adsorption mechanisms through direct experimental characterization of nanoparticle-pore surface interaction forces

Wednesday, 15 May 2024 12:00 (15 minutes)

The adsorption of nanoparticles on the pore surface could change surface wettability and slip length, which is dominant for EOR during nanofluid flooding. It is of great value to understand the adsorption mechanism of nanoparticles on the pore surface. The interactions between nanoparticles and pore surface include four significant and common forces, such as Van der Waals force, electrostatic force, attractive hydrophobic force, and repulsive steric force.

Forces were measured directly with the colloidal probe technique of atomic force microscope (AFM), which permits colloidal particles to attach to the cantilever. The forces, obtained in solutions with different salinity, varied from repulsive to attractive, which could be well fitted with the four forces mentioned above. Different forces exert their effects at different distances, among which the action range of Ver der Waals force (about 5 nm) is the least and that of electrostatic force (nearly 40 nm) is the largest. Based on the analysis of the theoretical equations, salinity is the most significant influence factor.

Molecular dynamics simulation was employed to verify the effect of different factors on the interaction between nanoparticle and pore surface. The all-atom models of nanoparticles were modified with alkanes of different densities and lengths to evaluate the repulsive steric force. Different ions with verified concentrations were added to the system to analyze the electrostatic force. The attractive hydrophobic force was assessed by calculating the radial distribution function of water molecules around nanoparticles. The conclusion obtained from molecular dynamics simulation is consistent with the experiment.

The nanoparticles transport with the nanofluids in real pores and throats, meaning the adsorption of nanoparticles is related to the drag force and lift force, which is generated by the flow of liquids. With this fact, the mechanical equilibrium equation of the nanoparticles adsorbed on the surface was established, based on which the maximum adsorption thickness was calculated. The degree of adsorption of the nanoparticle layer on the pore surface could be significantly enhanced by slightly increasing salinity. Our results provide useful insights into the adsorption mechanism of modified nanoparticles on pore surfaces, with important implications for the effective and economical application of nanofluid flooding in different reservoirs.

Acceptance of the Terms & Conditions

[Click here to agree](#)

Student Awards

I would like to submit this presentation into the MDPI student poster award.

Country

China

Porous Media & Biology Focused Abstracts

References

Conference Proceedings

I am interested in having my paper published in the proceedings.

Primary author: HAN, Mingliang

Co-authors: YUAN, Bin; LI, Dongming; ZHANG, Wei

Presenter: HAN, Mingliang

Session Classification: MS11

Track Classification: (MS11) Microfluidics and nanofluidics in porous systems