Improved oil recovery in nanopores: NanoIOR

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The flow of fluids through nanopores is indeed very intriguing. At nanoscale, the fluids properties may considerable change due to the surface and spatial confinament effects. In this work, we explore the water and oil flow through amorphous silica nanopores to simulate the fluid infiltration on geological porous media by non-equilibrium molecular dynamics simulations. Particularly, the displacement of oil with and without previous contact with water to emulate an improved oil recovery process by water flooding at nanoscale (NanoIOR). The simulated silica nanopores are rough with 1 to 4 nm diameters and have two different passivations to assess varying hydrophilicities. We have observed a barrier-less infiltration of water and oil on the empty nanopores, which indicates the possibility to have oil located on these nanopores. The radial density distributions, interfacial tensions, viscosities and critical applied pressures for infiltration have been determined for both hidrophilic and hidrophobic pores. For the water displacement by oil, a critical pressure of 1000 atm was observed, and after the flow was steady, a water layer remains adsorbed to the surface. Thus, hindering the direct contact of the oil with the surface. In addition, oil displacement by water was assessed. The simulations were carried out with and without the adsorbed water layer (AWL). Without the AWL, the applied pressure needed for oil infiltration was 5000 atm, whereas, with the adsorbed water layer, the infiltration was observed for applied pressures as low as 10 atm. Hence, the infiltration is greatly affected by the AWL, lowering the needed pressure to displace the oil in three orders of magnitude.

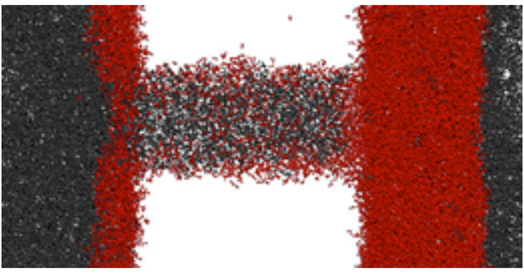

Fig. A snapshot of the oil infiltrating water filled silica nanopore process by molecular dynamics.