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Microfluidic study on migration of fluids and displacement efficiency via cyclic injection

hyejin Ahn (1), Sookyun Wang (1), Minhee Lee (2), Jeong-Gi Um (1), and Seon-Ok Kim (1)

(1) Pukyung National University, Energy Resources Engineering, Korea, Republic Of (dksgpwls517@naver.com), (2) Pukyung National University, Earth Environmental Science, Korea, Republic Of

Geological CO_2 sequestration is an important approach to reduce CO_2 emission into the atmosphere by isolating a large amount of CO_2 in underground geological formation. Such an approach involves injecting supercritical CO_2 into porous formation saturated brine and causes $scCO_2$ flooding with immiscible displacement. The displacement efficiency of CO_2 in porous formation is determined by hydraulic properties of the porous media and interfacial properties of CO_2 and brine in affecting CO_2 migration and pore water displacement.
The objectives of this experimental study is to observe the displacement patterns of immiscible fluids through microscopic pore structure in microfluidic chips and to estimate displacement efficiency of an injecting fluid over the course of multiple drainage-imbibition cycles. In this study, cyclic injection experiments by applying n-hexane used as a proxy fluid of $scCO_2$ were conducted to investigate cyclic displacement pattern of n-hexane and water and the change of displacement efficiency according to the cycle. In order to quantitatively analyze migration of fluids by cyclic injection in pore network, the image of displacement patterns and distribution of n-hexane and pore water are acquired through an imaging system with a microscope. The experimental observation results could provide an understanding to predict the behavior and distribution of CO_2 and pore water by reservoir environmental conditions and drainage-imbibition cycles