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Microfluidic hydrogen storage capacity and residual trapping during cyclic injections

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Underground hydrogen storage (UHS) in porous media offers a long-term and large-scale storage solution which is vital for a sustainable H2 economy. Despite growing interest in the topic, the understanding of the physical processes during cyclic H2 flow is not yet adequate. Here we use microfluidics to experimentally investigate multiple cycles of H2 injection and withdrawal under a range of injection rates at shallow reservoir storage conditions. Our analysis is aimed at qualitative and quantitative description of H2 reconnection mechanisms and hysteresis. We find that H2 storage capacities increase with increasing injection rate. The residual H2 saturation is reproducible between cycles, but its distribution in the pore space visually appears to be hysteretic. In most cases, the residually trapped H2 reconnects in the subsequent injection cycle, predominantly in proximity to the large pore clusters. Our results provide valuable experimental data to advance the understanding of multiple H2 injection cycles in UHS schemes.

Participation

In-Person

References

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