Assessment of extended DLVO-based water film on multiphase transport behavior in shale microfractures

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August 10, 2020

Abstract

This study presents a novel model to predict gas-water two-phase transport behaviors in shale microfractures by incorporating a mobile water film with varying thickness according to the extended Derjaguin-Landau-Verwey-Overbeek (DLVO) theory as well as multiple fluid transport mechanisms (i.e., real gas transport controlled by the Knudsen number and water slippage). This model is implemented in real shale microfractures via digital-core imaging. A gas-water displacement process is modelled by the invasion percolation theory, while a local multiphase distribution is determined by combining disjoining pressure with capillary force. Key findings reveal that gas relative permeability (RP) decreases by 17% and water RP enhances by 33.5%, when the mean aperture decreases from 1.67 to 0.0418μm. Neglecting water film brings a decrease in water RP and an overestimation of gas transport ability. Moreover, two critical microfracture apertures are determined, which enhances an understanding of the water film impact on gas-water transport properties in application.

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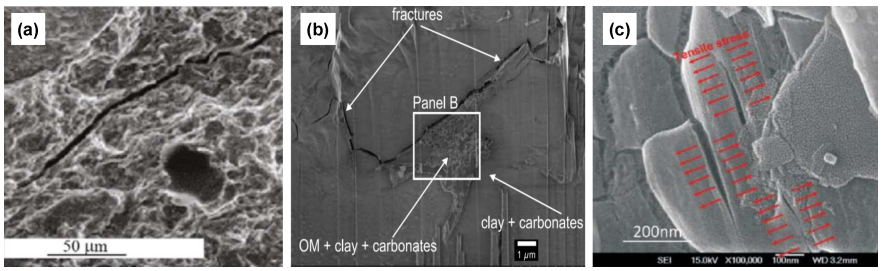

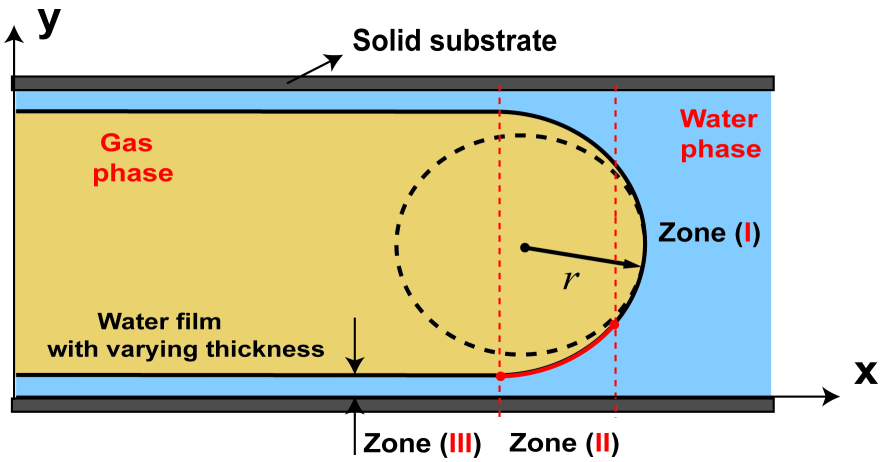

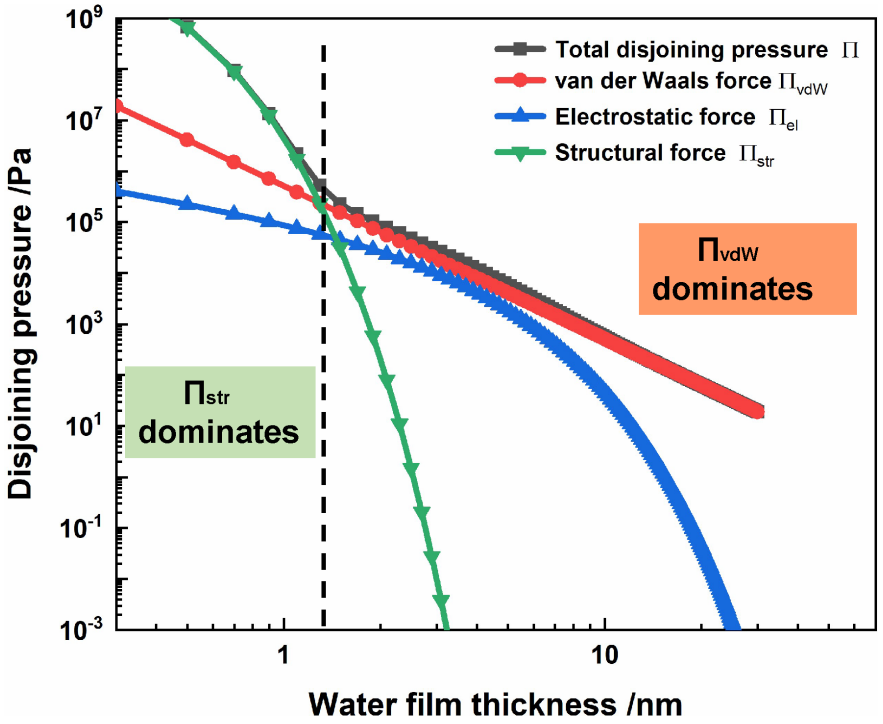

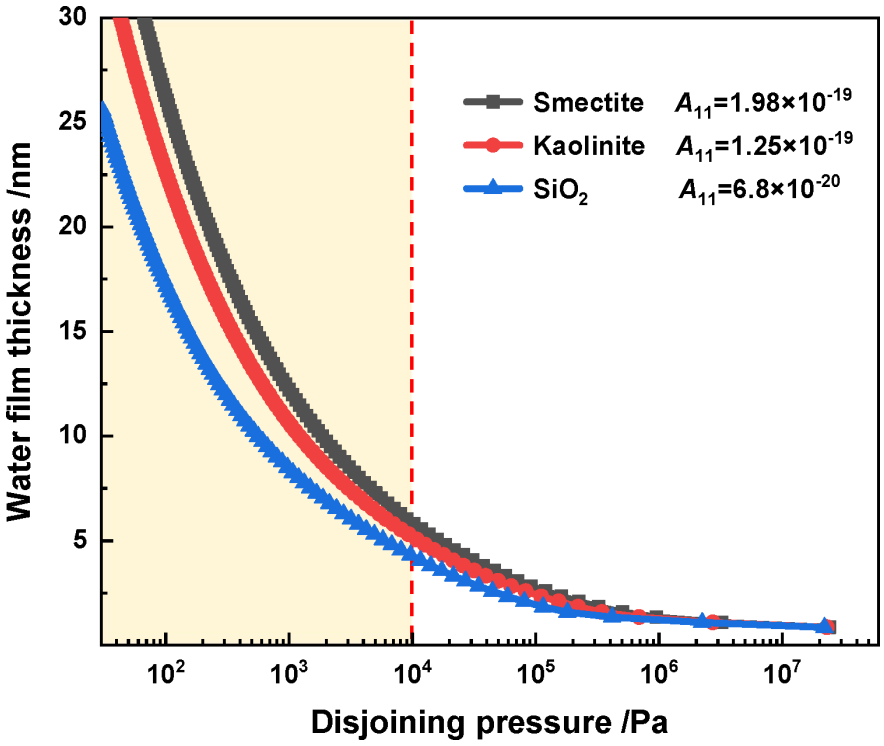

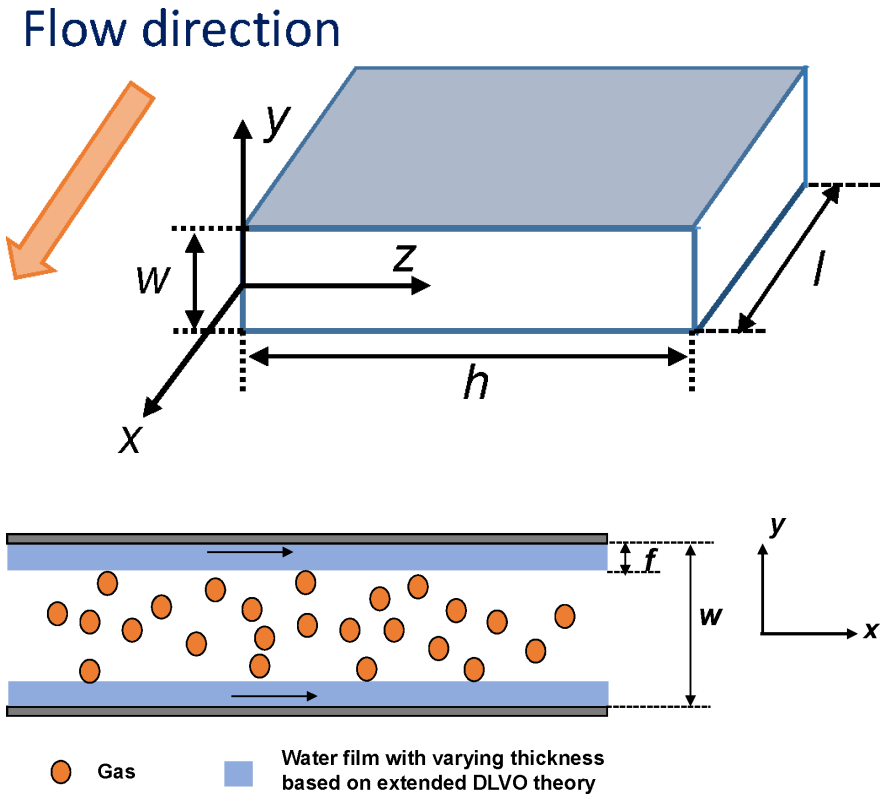

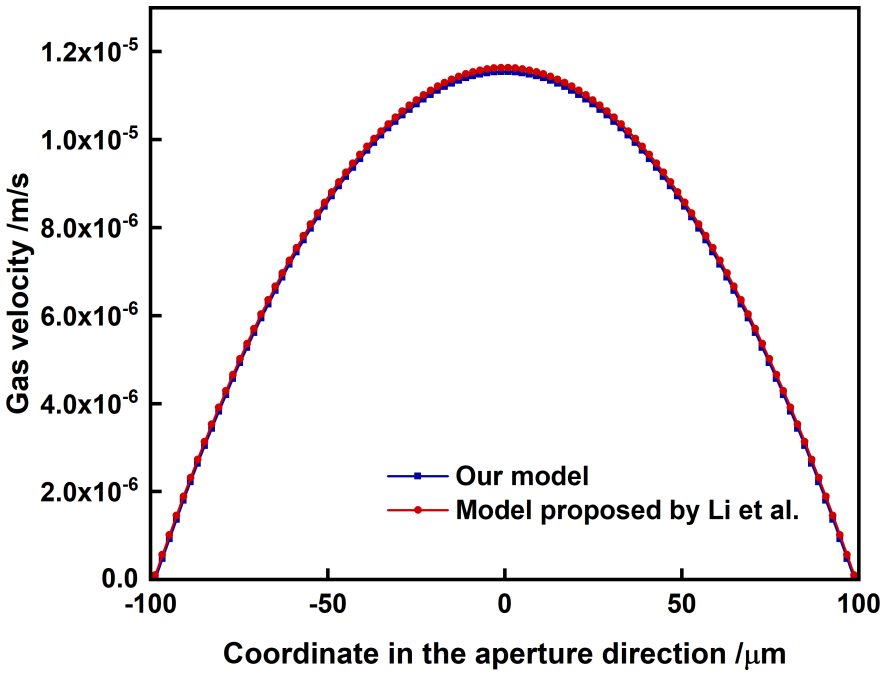

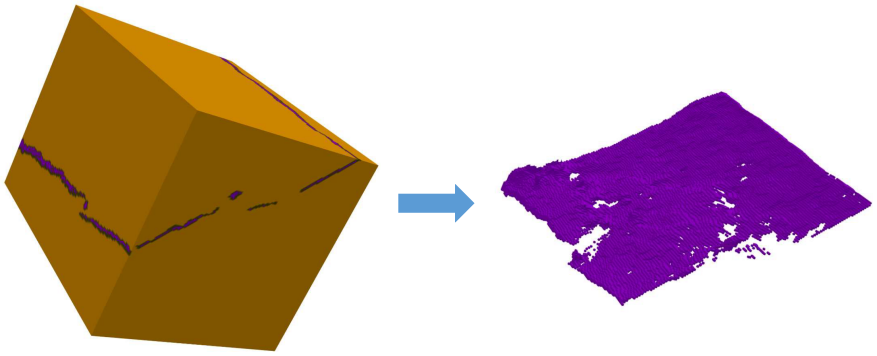

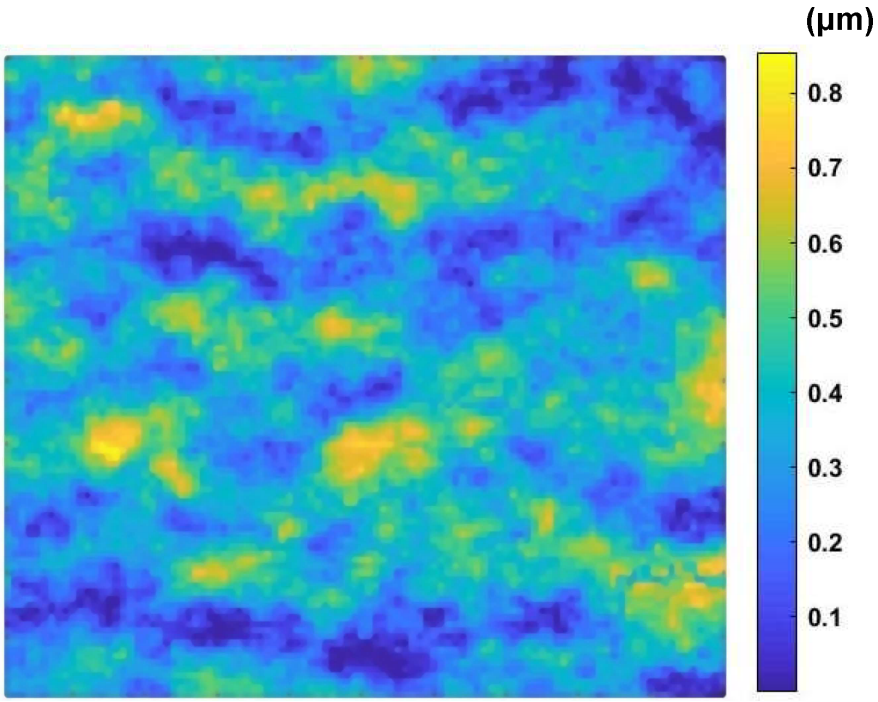

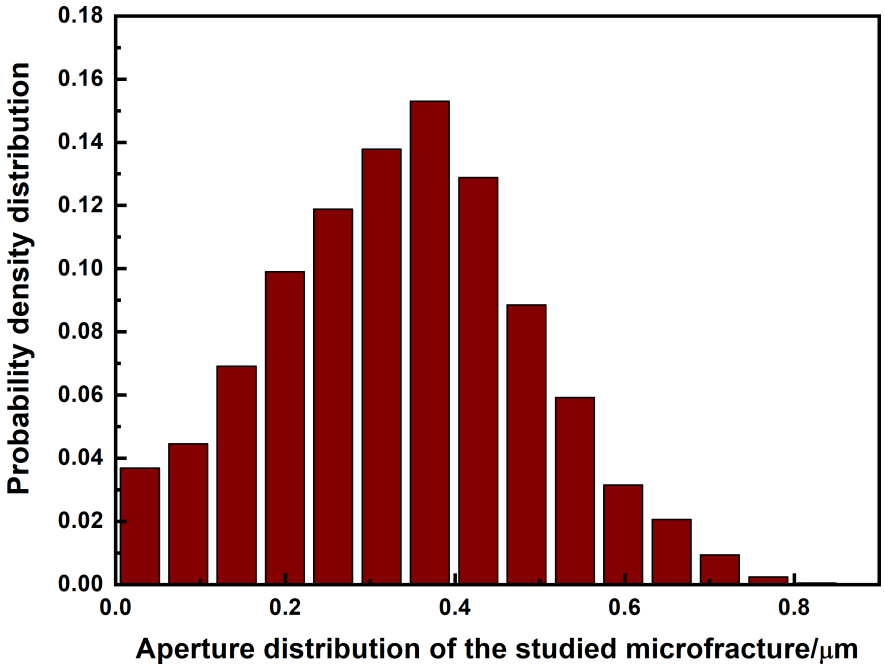

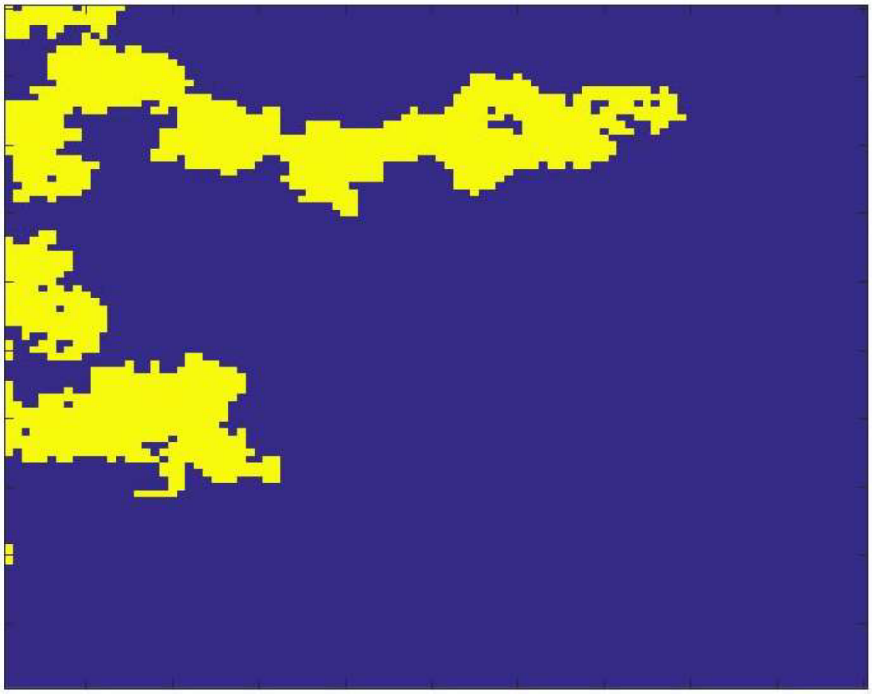

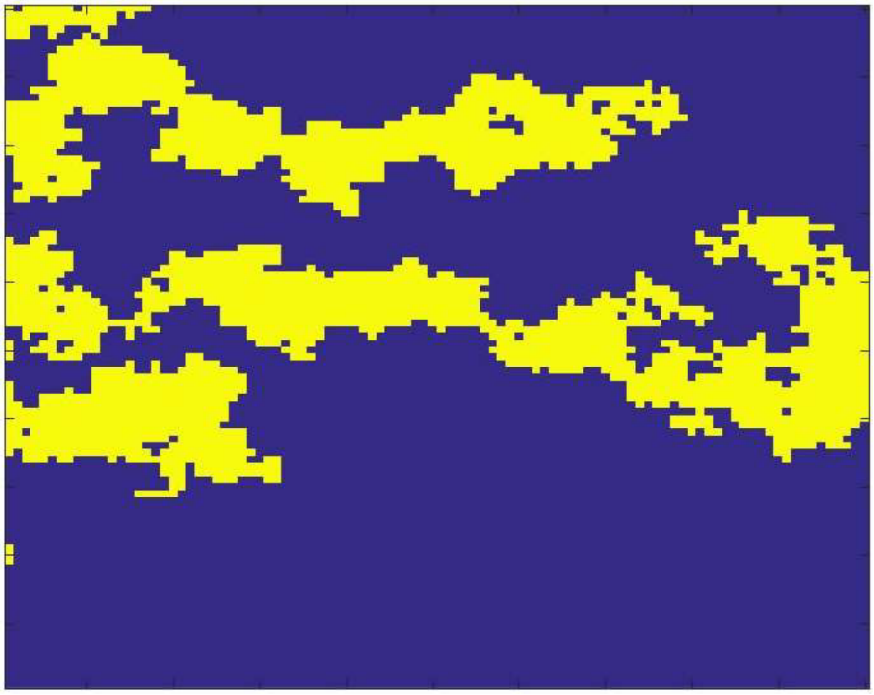

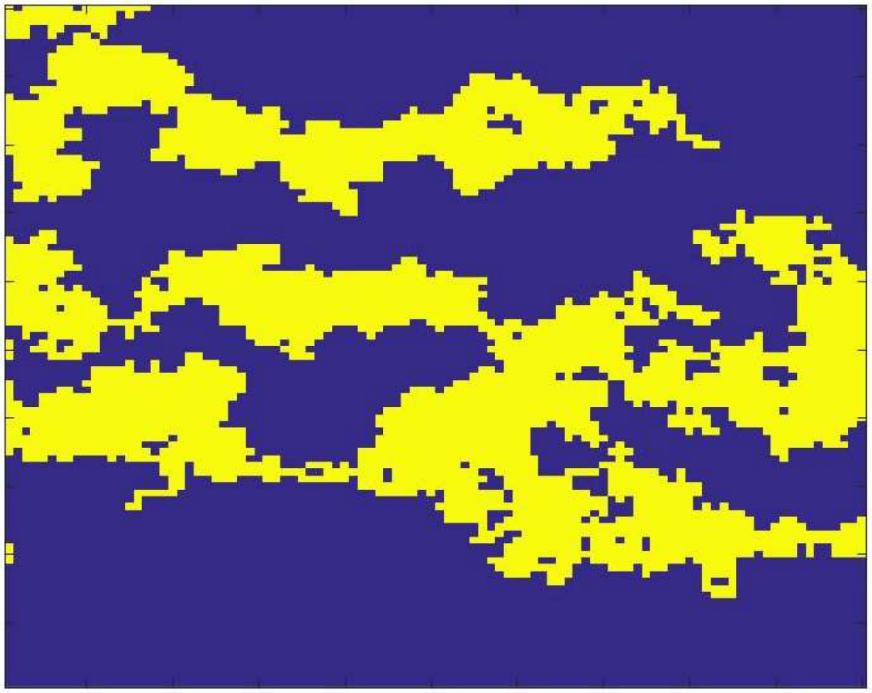

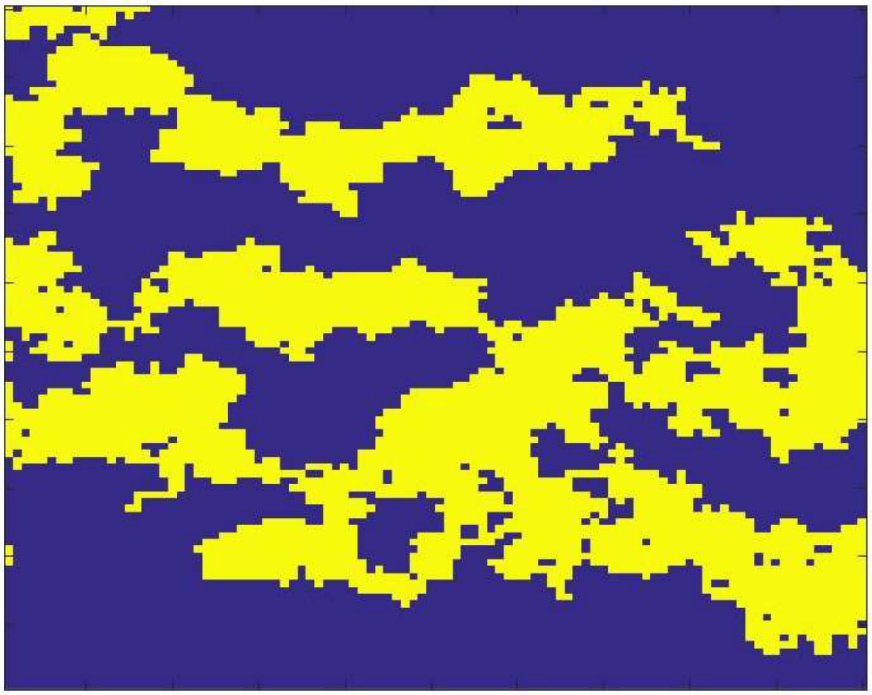

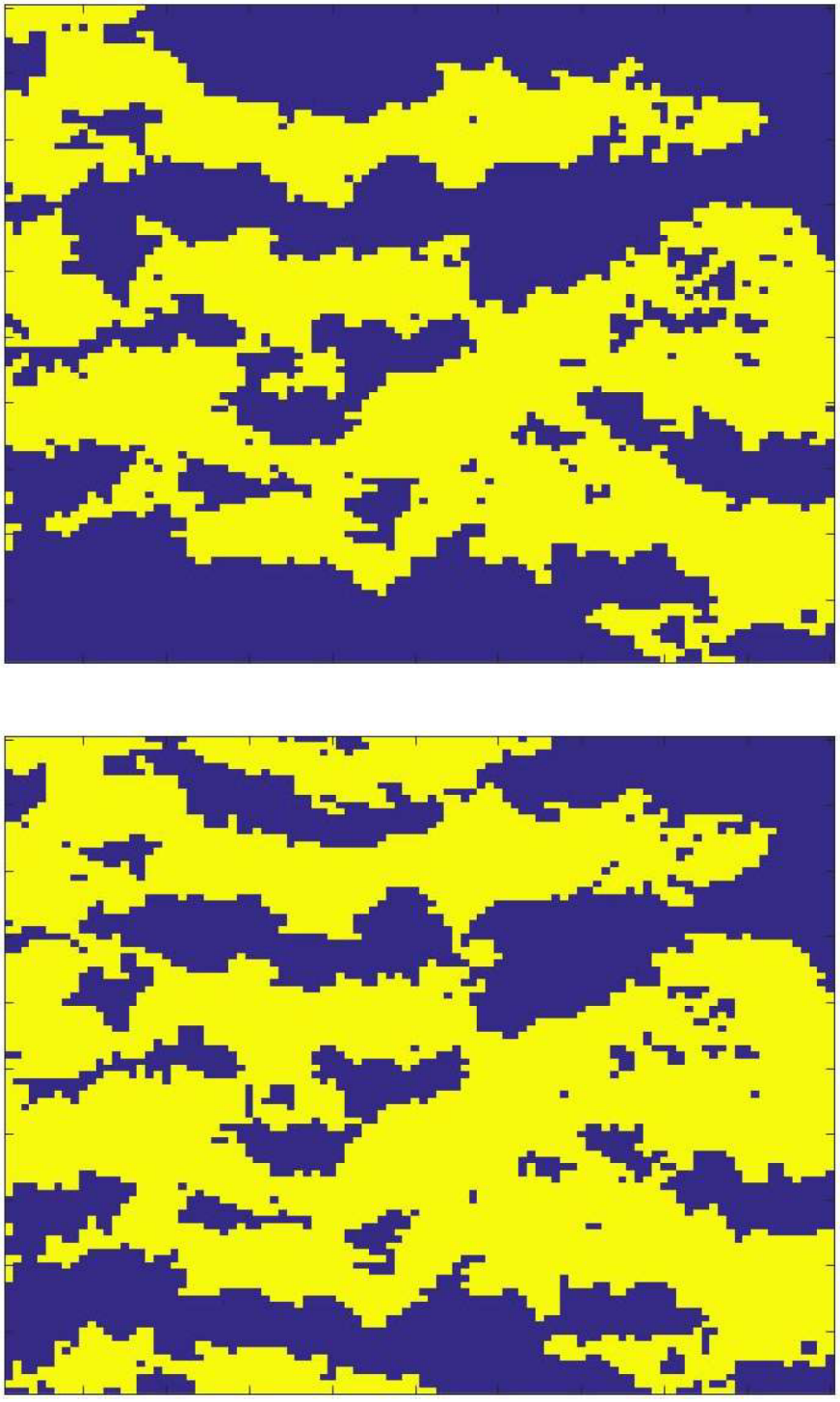

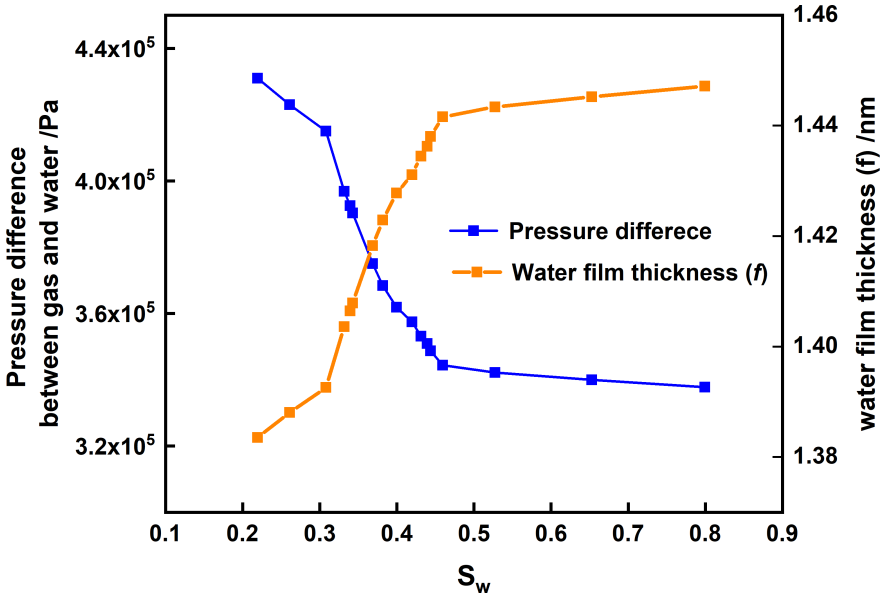

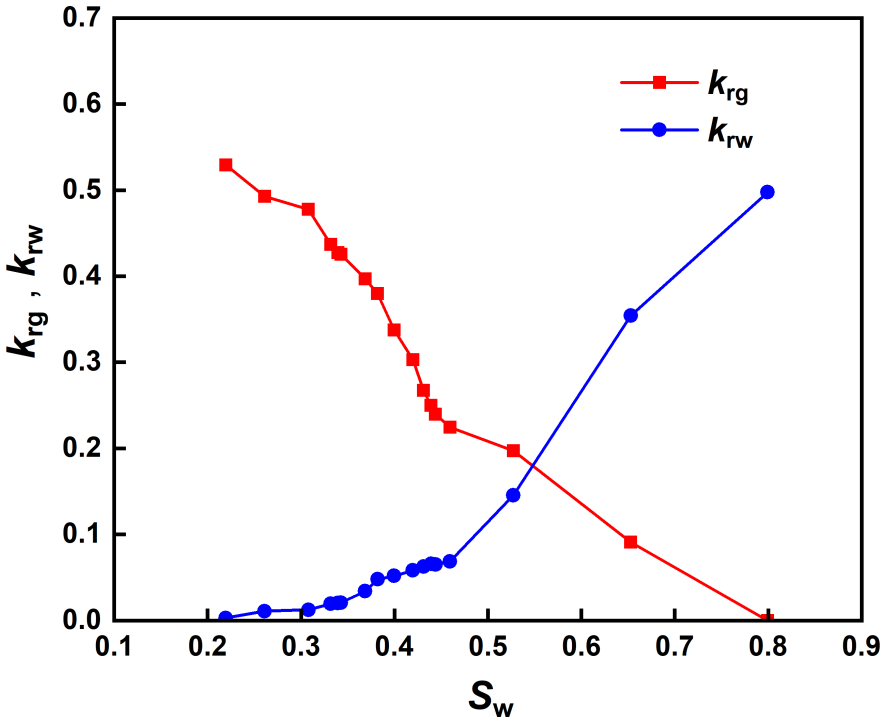

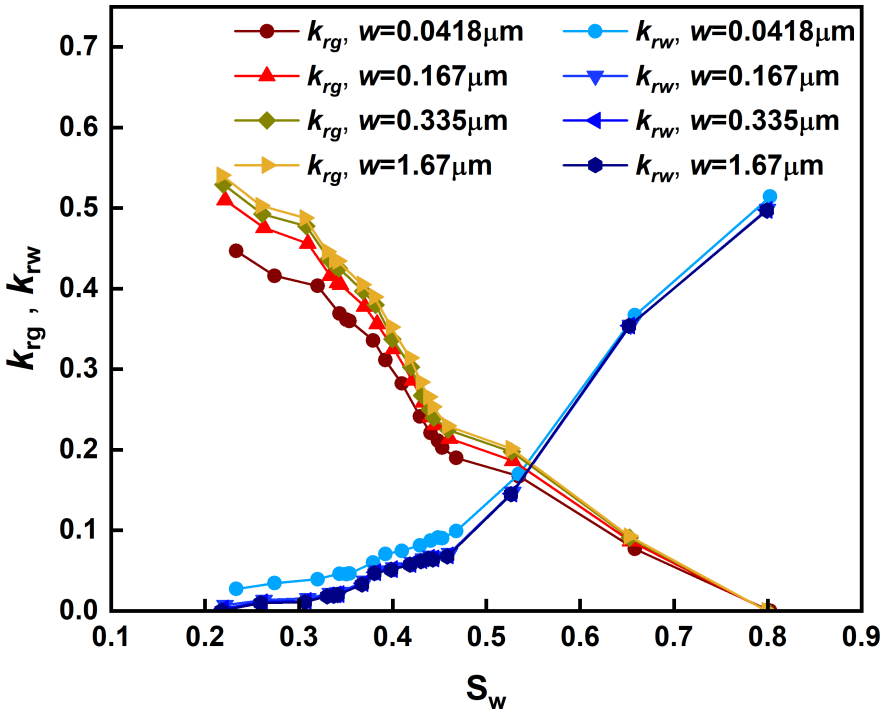

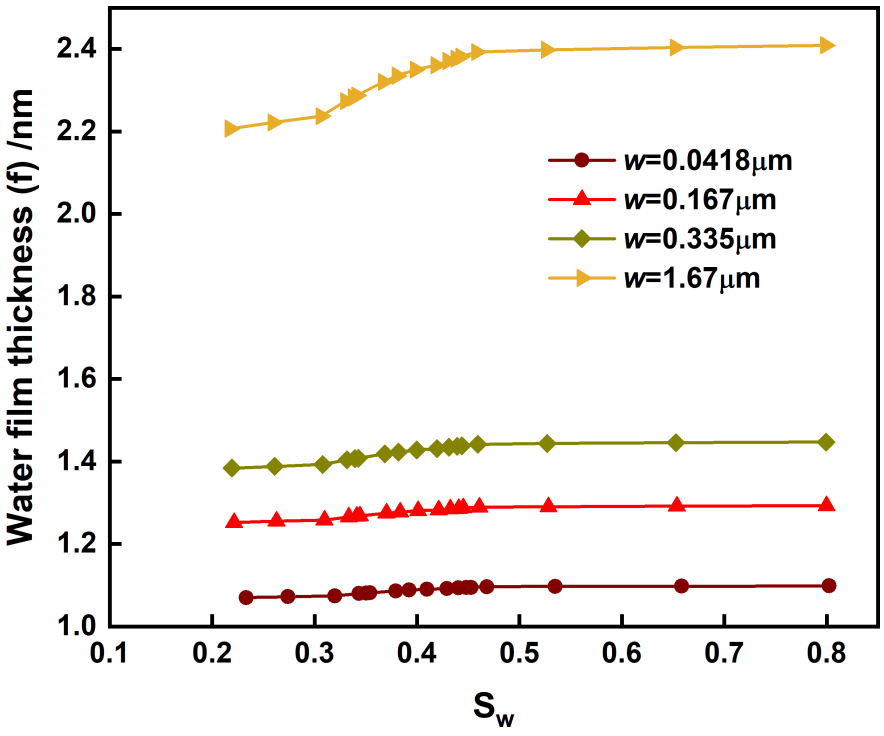

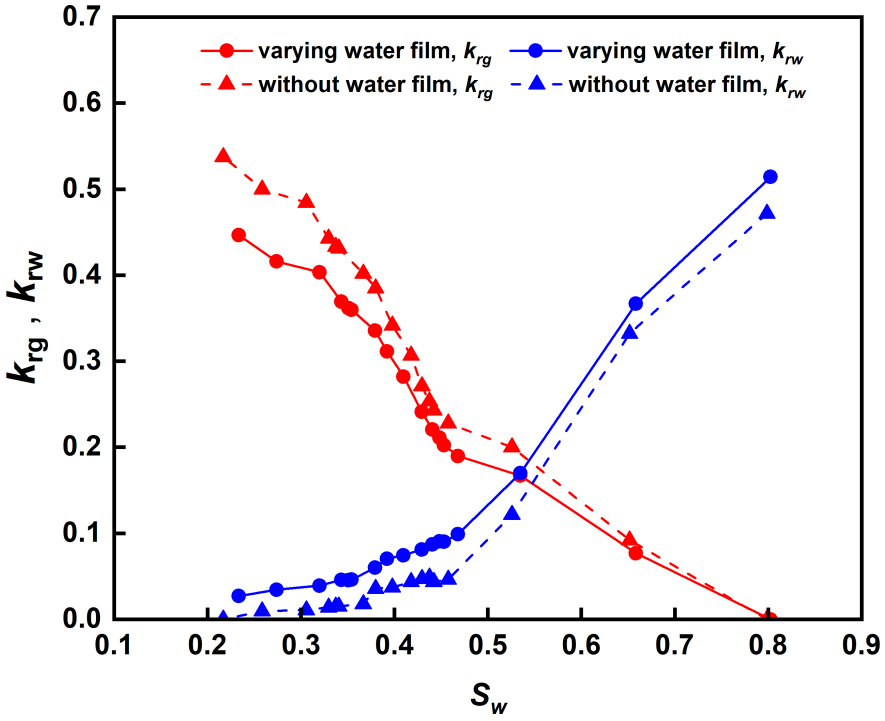

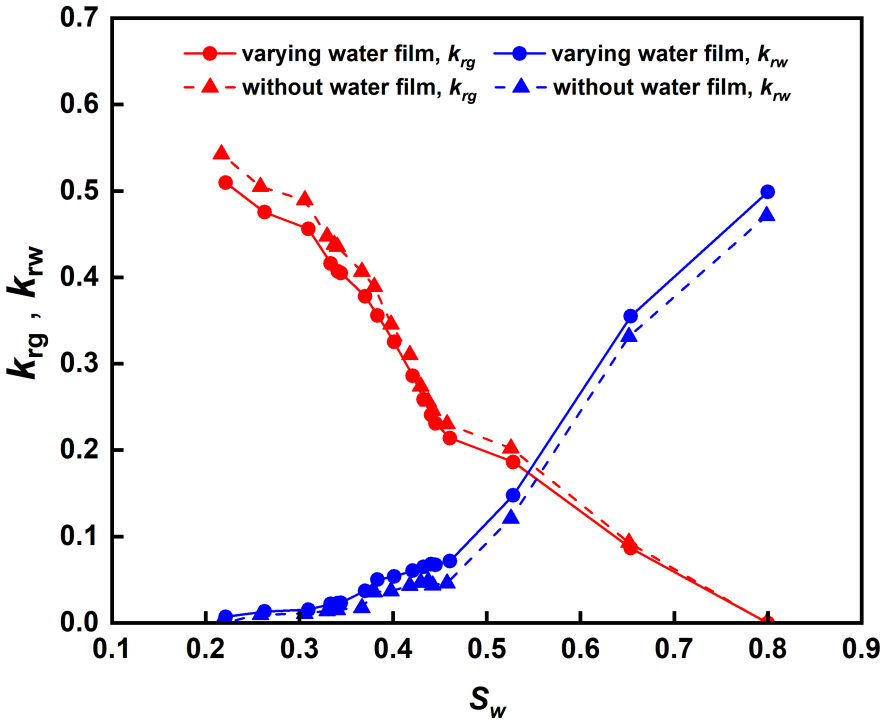

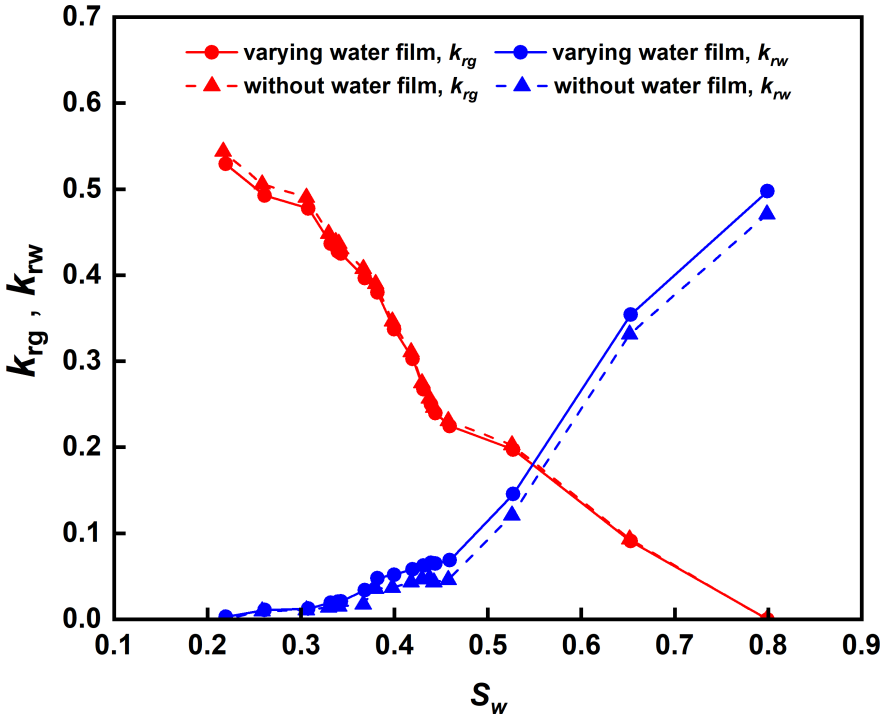

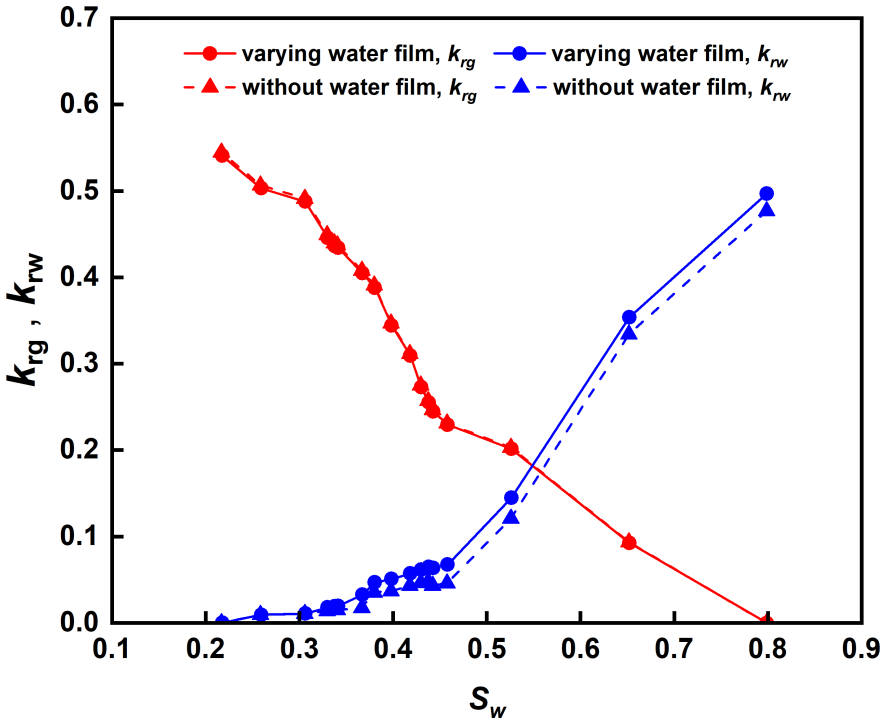

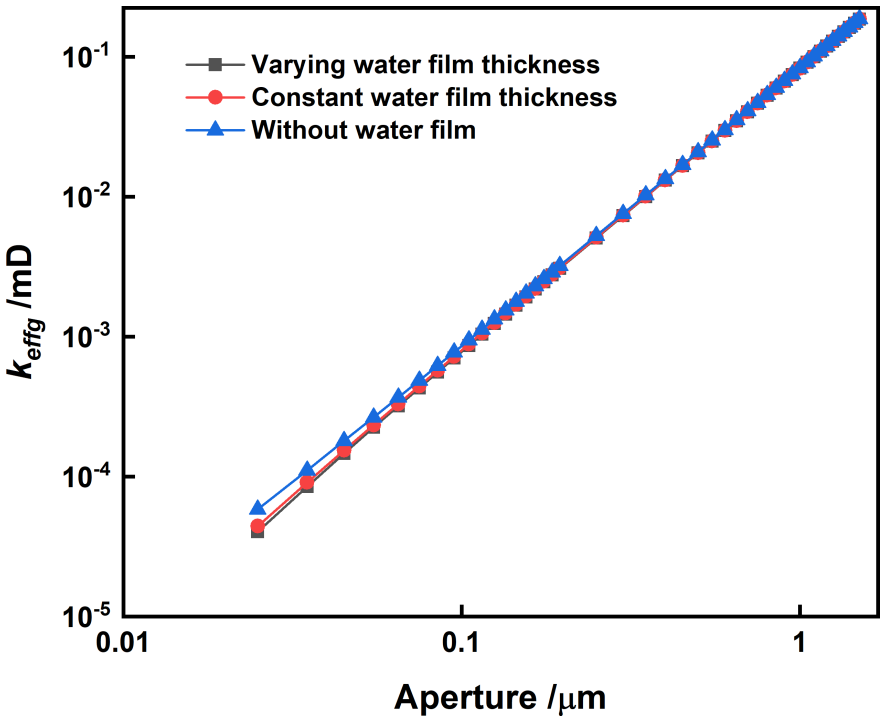

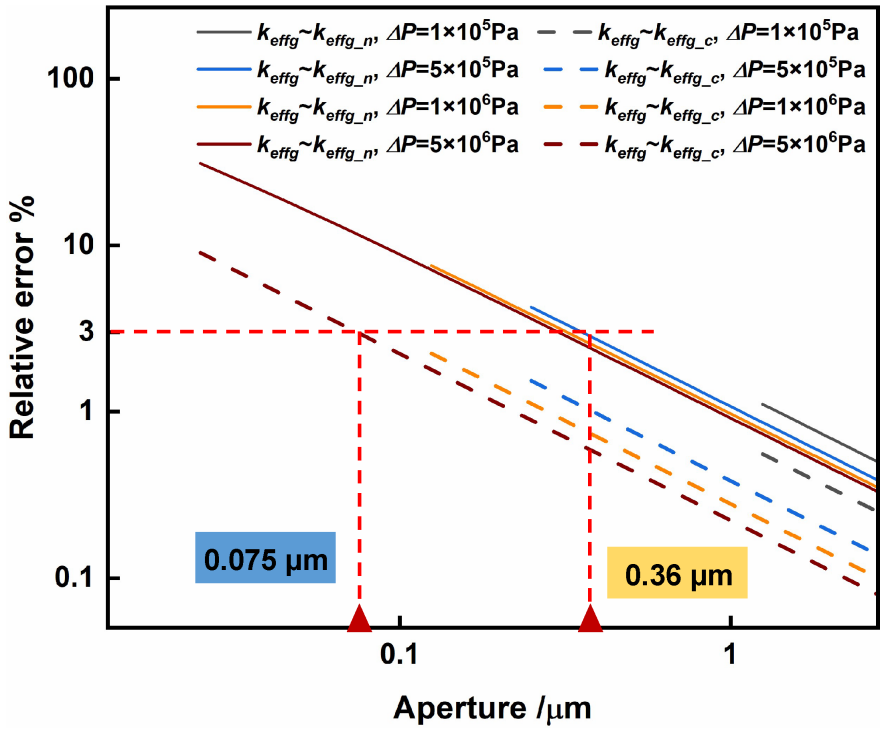

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