Beitrag ID: **35** Typ: **Talk**

Beyond the Cassie-Baxter Model: New Insights for Predicting Imbibition in Complex Systems

Donnerstag, 20. Februar 2025 09:40 (20 Minuten)

We revisit the classical problem of liquid imbibition in a single pore with spatially varying wettability. Starting from the Lucas-Washburn equation, we derive analytical solutions for the imbibition time (crossing time) in systems where wettability alternates between two materials. For ordered arrangements, we demonstrate that the imbibition speed depends non-trivially on the spatial distribution, with the "more hydrophobic-first" configuration being optimal. For disordered systems, where segment lengths follow a Gaussian distribution, we show that the classical Cassie-Baxter contact angle, originally derived for static wetting, fails to predict the dynamics of capillary-driven flow. To address this, we propose a new harmonic averaging method for the contact angle, which accurately predicts the viscous crossing time in such heterogeneous systems. Our findings reveal fundamental insights into the role of wettability heterogeneity in capillary-driven flow, offering a basis for understanding imbibition dynamics in complex heterogeneous systems.

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Sitzung Einordnung: Short Talks