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Secondary flows and bubbly drag reduction on heterogeneously rough surfaces in Taylor–Couette turbulence[1] PIM BULLEE, DENNIS BAKHUIS, RODRIGO EZETA, SANDER HUISMAN, Twente University, CHAO SUN, Tsinghua University, ROB LAMMERTINK, DETLEF LOHSE, Twente University — We investigate turbulent flow at Reynolds numbers (Re) ranging from 0.5×10^6 till 1.8×10^6 over surfaces that are composed of rough and smooth patches. Our main interest is in how the structure of the flow is influenced by this alternating rough and smooth surface, and how this changes the position of air bubbles in the flow. For this we use the Taylor–Couette geometry, which allows for accurate drag and flow measurements, as well as flow visualisations through its transparant outer cylinder. The inner cylinder wall is covered with sandpaper, leaving room between bands to form a constant pattern in axial direction. This results in a strong secondary flow pattern of radially outward flow on the rough patches and radially inward flow on the smooth patches. Surprisingly, air bubbles do not follow this secondary flow, but rather accumulate on top of the rough wall sections in the flow. Here, locally, the drag is largest and so the drag reducing effect of the bubbles is felt strongest. Therefore, a larger maximum value of bubbly drag reduction is found for the alternating rough and smooth inner cylinder walls compared to the completely rough and completely smooth inner cylinder walls.

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Pim Bullee
Twente University

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