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Enhanced transport by grooved walls in turbulent Taylor-Couette flow XIAOJUE ZHU, RODOLFO OSTILLA-MONICO, ROBERTO VERZICCO, DETLEF LOHSE, Physics of Fluids Group, University of Twente — We present direct numerical simulations of Taylor-Couette flow with grooved walls at a fixed radius ratio $\eta = r_i/r_o = 0.714$ with inner cylinder Reynolds number up to $Re_i = 3.76 \times 10^4$, corresponding to Taylor number up to $Ta = 2.15 \times 10^9$. The grooves are axisymmetric V-shaped obstacles attached to the wall with a tip angle of 90°. Results are compared with the smooth wall case in order to investigate the effects of grooves on Taylor-Couette flow. We focus on the effective scaling laws for the torque, flow structures, and boundary layers. It is found that, when the groove height is smaller than the boundary layer thickness, the torque is the same as that of the smooth wall cases. With increasing Ta, the boundary layer thickness becomes smaller than the groove height. Plumes are ejected from tips of the grooves and a secondary circulation between the latter is formed. This is associated to a sharp increase of the torque and thus the effective scaling law for the torque vs. Ta becomes much steeper. Further increasing Ta does not result in an additional slope increase. Instead, the effective scaling law saturates to the "ultimate" regime effective exponents seen for smooth walls.

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