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Frictional Torque Reduction in Taylor-Couette Flows with Riblet-Textured Rotors SHABNAM RAAYAI, GARETH MCKINLEY, Massachusetts Inst of Tech-MIT — Inspired by the riblets on the denticles of fast swimming shark species, periodic surface microtextures of different shapes have been studied under laminar and turbulent flow conditions to understand their drag reduction mechanism and to offer guides for designing optimized low-friction bio-inspired surfaces. Various reports over the past four decades have suggested that riblet surfaces can reduce the frictional drag force in high Reynolds number laminar and turbulent flow regimes. Here, we investigate the effect of streamwise riblets on torque reduction in steady flow between concentric cylinders, known as Taylor-Couette Flow. Using 3D printed riblet-textured rotors and a custom-built Taylor-Couette cell which can be mounted on a rheometer we measure the torque on the inner rotor as a function of three different dimensionless parameters; the Reynolds number of the flow, the sharpness of the riblets, and the size of the riblets with respect to the scale of the Taylor-Couette cell. Our experimental results in the laminar viscous flow regime show a reduction in torque up to 10% over a wide range of Reynolds numbers, that is a non-monotonic function of the aspect ratio and independent of Re. However, after transition to the Taylor vortex regime, the modification in torque becomes a function of the Reynolds number, while remaining a non-monotonic function of the aspect ratio. Using finite volume modelling of the geometry we discuss the changes in the Taylor-Couette flow in presence of the riblets compared to the case of smooth rotors and the resulting torque reduction as a function of the parameter space defined above.

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