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Water Flows in Copper and Quartz Nanochannels

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In the present paper the generalised Navier–Stokes theory – the theory of micropolar fluids – has been applied to water flows in narrow channels. The predictions for velocity and microrotation are compared with molecular dynamics simulations of water flows. Two channel widths, equal to 5 and 10 diameters of a water molecule are considered. Two kinds of the channel walls, made of quartz and copper, are taken into account. The obtained results show that the micropolar theory gives a reasonable description of the flow for the wider channel only. In all considered cases a velocity slip and non-zero microrotation at the walls could be observed. The slip effects are more pronounced for smaller channel widths and for walls made of copper. The interaction of water molecules, which have dipole moment, with the electric charges at the quartz crystals seem to have at least some influence on the slip and microrotation at the walls.

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