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Complex flows of immiscible microfluids and nanofluids between coaxial tubes

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Complex micro/nanofluids are composed by the micro/nano particles suspended in a liquid. At that scale solid particles possess unique physical properties like high strength, hardness, thermal and electric conductivity, and magnetic susceptibility. Such fluids are excellent candidates for the fluid-based coolers/heaters, particle separation systems, fuel cells. Instead of the no slip condition at solid walls, the micro/nanofluids obeys the first/second order velocity slip conditions, that provides novel interesting phenomena in comparison to conventional liquids. In this contribution the steady flows of immiscible liquids with different concentrations of nanoparticles between two coaxial cylinders are studied. The governing equations and boundary conditions are

$$div(\bar{v}_j) = 0, \qquad m_j \mathrm{D}\bar{v}_j = \mathrm{C}p, \tag{1}$$

$$v_q^{1,3} - a_{1,3}Kn\frac{dv_q^{1,3}}{dr} + b_{1,3}Kn^2\frac{d^2v_q^{1,3}}{dr^2}\bigg|_{r=R_{1,2}} = \mathrm{W}_{1,2}R_{1,2}, \tag{2}$$

$$(v_q^1 - v_q^2)\Big|_{r=R_1+d_1} = (v_q^2 - v_q^3)\Big|_{r=R_2-d_2} = (m_1v_q^1 - m_2v_q^2)\Big|_{r=R_1+d_1} = (m_2v_q^2 - m_3v_q^3)\Big|_{r=R_2-d_2} = 0 \tag{3}$$

for the Couette flow between rotating cylinders, and

$$v_x^{1,3} - a_{1,3}Kn\frac{dv_x^{1,3}}{dr} + b_{1,3}Kn^2\frac{d^2v_x^{1,3}}{dr^2}\bigg|_{r=R_{1,2}} = 0, \quad p\Big|_{x=0,L} = P^{\pm} \tag{4}$$

for the Poiseuille flow between the axial tubes, where the indexes $v^{1,3}$ correspond to the layers in contact with walls, Kn is the Knudsen number, a, b are slip coefficients [1]. Solutions of (1)-(3) and (1),(4) have been found as expansions and analized. Novel particle concentration dependent phenomena have been found.

1. *Karniadakis G.E., Beskok A., Aluru N.* Microflows and nanoflows: Fundamentals and simulation. // Interdisc. Appl. Math. Series, - 2005. – **29**. - P.51-77.