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Stress Boundary layer Development in Planar flow of Viscoelastic Fluids NARIMAN ASHRAFI, MEYSAM MOHAMADALI, Young Researchers and Elites Club, Science and Research Branch, Islamic Azad University, Tehran, Iran — Two-dimensional steady planar creeping flow of the nonlinear viscoelastic Upper Convected Maxwell (UCM) fluid along a flat plate is analyzed for high Weissenberg numbers, Wi. The viscoelastic boundary layer, formed in a thin region closer to the wall in which the relaxation terms are recovered. By means of similarity transformations the non-linear momentum and constitutive equations in each layer transform into a system of highly nonlinear coupled ordinary differential equations. The proper similarity variable is found that asymptotically matches each two adjacent layers. The numerical simulation shows that at the outer layer, the velocity profile changes linearly with the similarity variable meaning that no velocity boundary layer is developed. In general, the boundary layer is formed in all three stress components in different fashions. The stress boundary layer divides the flow into two separate regions of viscoelastic and elastic flows, in addition to the top outer flow. The viscoelastic region is completely bounded in two directions (x and y) for horizontal normal stress, T_{xx}, and shear stress, T_{xy}. Finally it is observed that the stress boundary layer for vertical stress, T_{yy}, is formed only in x direction.

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