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Role of viscosity and surface tension of zebrafish embryonic tissues in tissue flows during gastrulation. E.M. SCHOETZ, MPI-CBG/-PKS, T. BACARIAN, UCI, M.S. STEINBERG, R.D. BURDINE, W. BIALEK, Princeton University, C.P. HEISENBERG, MPI-CBG, R.A. FOTY, UMDNJ, F. JULICHER, MPI-PKS — At the onset of gastrulation in zebrafish, complex flows and cell movements occur, which are not well understood. Here, we study the material properties of zebrafish embryonic tissues which are important for the tissue dynamics. We found that these tissues behave viscoelastic and exhibit liquid-like properties on long time scales. They relax internal stress caused by compressive forces or, in the absence of external forces, round up and fuse into spheres to minimize their free surface. Quantitative differences in the adhesivity between different types of tissues result in their immiscibility and sorting behavior analogous to that of ordinary immiscible liquids. When mixed, cells segregate into discrete phases, and the position adopted correlates with differences in the aggregate surface tensions for these phases. Surface tensions were measured with a tissue surface tensiometer. Aggregates were compressed and their force response and shape were recorded as a function of time. From the analysis of the force-relaxation curves, we determined the surface tensions, relaxation times, tissue viscosities and shear moduli. Furthermore, by 4D-cell tracking, we measured kinetic parameters such as cell speed, directionality and persistence of cell movement.

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