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A Tale of Two Viscosities

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We describe a series of large-strain, two-dimensional simple-shear numerical experiments on two-phase linear and non-linear viscous materials. The modal percentage of the two-phases, their relative viscosities and the stress exponent of the dependence of viscosity on stress were systematically varied, allowing us to observe the effects of these parameters on the flow behaviour of the system. All experiments exhibited strain localisation, but the extent and type of localisation varied considerably, and the range of parameters allows both classical SC as well as SC' structures to form.

The intergranular finite strain geometries also varied systematically, although there is a trade-off between non-linearity of viscosity and the viscosity contrast that results in similar geometries for quite different mechanical behaviour. The finite rotation of the harder phases was similar within any one experiment, resulting in sub-parallel arrays of initially parallel passive markers.

The finite rotation of the isolated harder phases was similar within any one experiment, resulting in sub-parallel arrays of initially parallel passive markers. Deformability and interaction of grains allows meta-stable grain elongation orientations to form, without any additional consideration of slip along surfaces. The slight variability of initial grain geometry and subsequent grain interactions leads to a wide variability in final grain shapes, for the same initial viscosities.