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Particle rotation as probe of resistance to interparticle sliding in the rheology of sintering

In conditions of constrained sintering, an aggregate's deformation may involve sliding along the interfaces of contact between particles. The boundary viscosity expressing the resistance to sliding is largely unknown. The motion of each particle is described by two vectors: the velocity of the particle centroid and the particle rotation rate. Interparticle sliding brings the decoupling of the two vectors, which adds degrees of freedom to the rheology. The work highlights two consequences: the dependence of shear viscosity on particle shape anisotropy, and the dependence of the flow on the gradient of rotation rate.

The flow of an isotropic 2D aggregate is analysed via two methods: (i) the computation of the mechanical equilibrium of the particles by minimization of dissipation; (ii) the simulation of the flow a micropolar (Cosserat) continuum mimicking the aggregate. Two straining modes are considered: a uniform strain rate created by periodic boundary conditions and a gradient of strain rate created by a couple applied on a nugget with variable size (possibly a single particle) centred into a crown of up to more than 900 particles. The work reveals that a low boundary viscosity coupled to a large particle shape anisotropy promotes particle rotation rate, which reduces the shear viscosity. The comparison of the two methods validates the micropolar viscosities to be ascribed to an aggregate and suggests potential routes for quantifying the resistance to boundary sliding.

Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

No interest

Invitation letter for visa

No

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