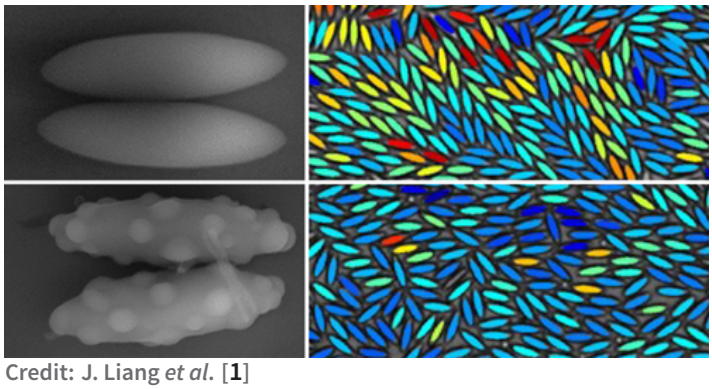
Bumpy Particles Take One Step to Become Glass

Roughing up the surfaces of particles in a colloidal system can smooth its transition into a glassy state.

By **Rachel Berkowitz**

For researchers studying the glass transition, a colloidal suspension sandwiched between microscope slides offers a convenient, easily observable model system. Recent work focusing on colloidal spheres suggests that the particles' surface texture plays an important role in the dynamics of glass formation. Now Jian Liang of Soochow University in China and colleagues have investigated the effect of texture when the colloidal particles are ellipsoidal [**1**]. They found that roughening up the surfaces of the ellipsoids simplifies the glass transition, causing it to skip over an intermediate state that's observed when the ellipsoids are smooth.

Ellipsoidal particles confined in a monolayer have two motional degrees of freedom within the plane: rotation and translation. When a suspension of smooth ellipsoidal particles approaches the glass transition—because of the packing density being increased, for example—rotational freedom is the first to go. In this "orientational glass," the densely packed particles can no longer rotate, but they can still glide and form clusters with shared alignments. Only when the packing density is increased further is this translational motion arrested and the glass translation completed.



Credit: J. Liang *et al.* [**1**]

Liang and his colleagues reproduced this two-step transition using a solution of 2-μm-diameter ellipsoids. Then they repeated the experiment but with each ellipsoid given a bumpy coating. This time, the rotational and translational motion ceased simultaneously. Simulations suggested that the rough surfaces cause the two types of motion to be coupled. Translation can no longer occur without rotation, and since rotation is inhibited, so too is translation.

The work provides a novel approach for manipulating the transition in colloidal systems. Altering the surface roughness, the researchers say, could offer pathways for designing materials with tailored properties.

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REFERENCES

1. J. Liang *et al.*, "Glass transition in monolayers of rough colloidal ellipsoids," **Phys. Rev. Lett. 134, 038202 (2025).**