

Electrostatic formation of liquid marbles

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Abstract—We report observations of a phenomenon in which electrostatically-charged glass ballotini particles are suddenly and explosively released from a particle bed, flow upwards across an air gap of several millimeters, and are engulfed by a pendant water drop. The drop completely fills with particles in a fraction of a second, forming a pearl-like metastable spherical agglomerate on the bed surface. A simple quantitative argument involving electrostatic stresses in the particle bed is provided to explain the sudden onset of the particle 'avalanche'. The novel class of agglomerate formed by this process is reminiscent of the 'liquid marbles' created by coating a drop with hydrophobic particles (which can also be created via the same process). However, in this case, the particles are hydrophilic. Complex multi-layered agglomerates might also be produced by this method, with potential industrial, pharmaceutical, environmental and biological applications.

