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Elastic amplification of the Rayleigh-Taylor instability in solidifying melts PIERRE-THOMAS BRUN, ETIENNE JAMBON-PUILLET , MATTHIEU ROYER- PIECHAUD, Princeton University — The concomitant deformation and solidification of melts is relevant to a broad range of phenomena. Examples include the preparation of cotton candy, the atomization of metal, the manufacture of glass fibers... The shape of the solids formed in these processes is typically determined through the competition between the deformation of the liquid phase and its solidification, such that solid-like deformations halfway through solidification are rarely envisioned. Here we show that very soft solids in the midst of solidification (G $\sim$ 100Pa) can be permanently deformed to form previously unknown periodic structures. Namely, we generate an array of droplets on a thin layer of liquid elastomer melt coated on the outside of a rotating cylinder through the Rayleigh-Taylor instability. Then, as the melt goes through its gelation point, we stretch these drops into elastic hairs. The ongoing solidification eventually hardens the material, erasing the memory of the deformations. Using experiment, simulation and theory, we demonstrate that this coupled liquid-elastic hair pattern can be rationalized by combining tools from fluid mechanics and elasticity.

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