Gas marbles able to roll around in the hand could be used to store gasses

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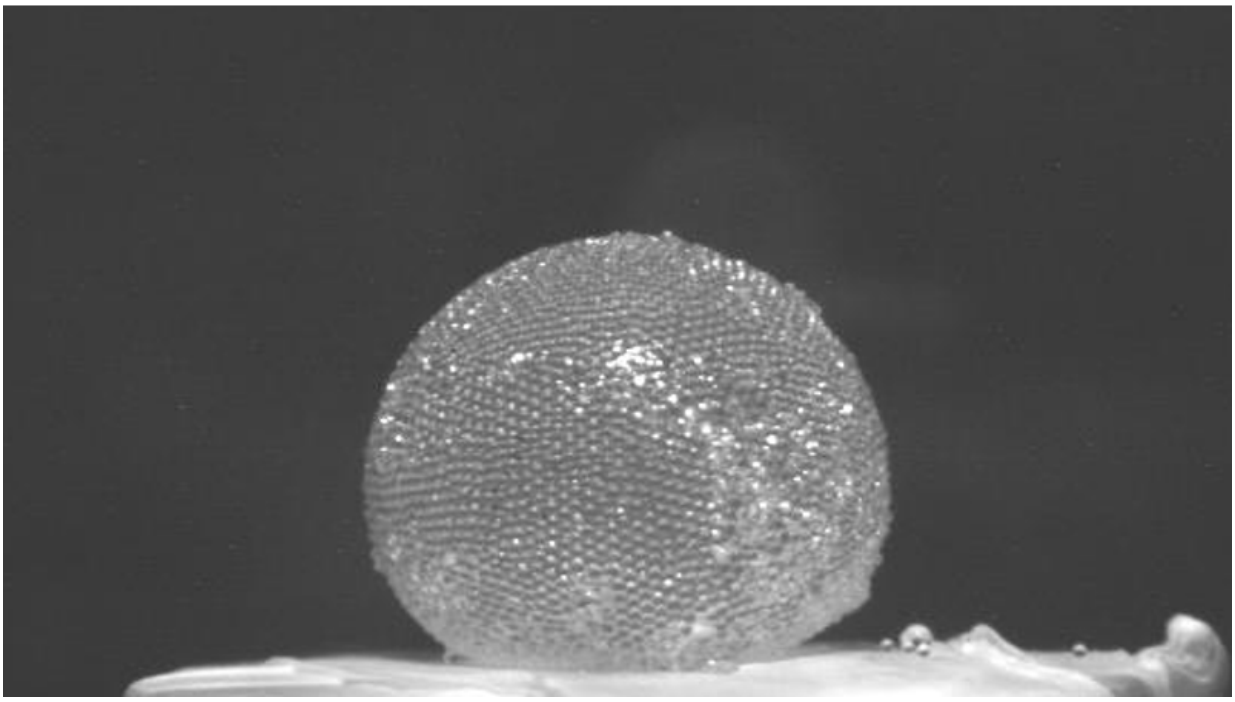

Hard outside, soft inside. The plastic shell of a gas marble can withstand at least 10 times atmospheric pressure, with no volume increase. Credit: Y. Timounay/UPE, via *Physics*

(Phys.org)—A trio of researchers with Université Paris-Est has discovered a new type of spherical bubble—called a gas marble, it is similar to bubbles made with soap, but has a coating of much smaller polystyrene microspheres. In their paper published in the journal

Physical Review Letters, the team describes how their discovery came about, some of the properties of the spheres, and possible uses for them.

The invention, like many others, came about by accident, the researchers report, as grad student Yousra Timounay was experimenting with the properties of little plastic balls in water. She discovered that when adding soap and using a rectangular mesh to retrieve the balls, a bubble would form just as it did with regular soap bubbles. But the microspheres appeared, too, covering the entire surface of the bubble. She and her colleagues named the result "gas marbles."

Further study of the gas marbles has not revealed the low-level process involved in their formation, though the researchers note that the microspheres were held together as a group by a liquid meniscus due to surface tension. They also found that they could insert a syringe into the marbles without popping them. They found that they could contain air up to 10 times atmospheric pressure before bursting and that they did not grow in size as would be expected. They also found they could reduce the pressure up to 10 times below atmospheric pressure before a marble collapsed—again, with no changes in size of the sphere.

The team reports that the gas marbles are strong enough to withstand being rolled around the palm of the hand, so long as it is done carefully. They suggest the gas marbles could possibly be used to force foam to stabilize or to store other gases. The team plans to continue studying the gas marbles starting with experiments designed to better understand the permeability of the spheres to determine which sorts of gases they may hold. They will also be looking into how long the marbles will last under various conditions before the water holding them together evaporates.

More information: Yousra Timounay et al, Gas Marbles: Much Stronger than Liquid Marbles, *Physical Review Letters* (2017). DOI:

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ABSTRACT

Enwrapping liquid droplets with hydrophobic particles allows the manufacture of so-called "liquid marbles" [Aussillous and Quéré Nature (London) 411, 924 (2001); Mahadevan Nature (London)411, 895 (2001)]. The recent intensive research devoted to liquid marbles is justified by their very unusual physical and chemical properties and by their potential for various applications, from microreactors to water storage, including water pollution sensors [Bormashenko Curr. Opin. Colloid Interface Sci. 16, 266 (2011)]. Here we demonstrate that this concept can be successfully applied for encapsulating and protecting small gas pockets within an air environment. Similarly to their liquid counterparts, those new soft-matter objects, that we call "gas marbles," can sustain external forces. We show that gas marbles are surprisingly tenfold stronger than liquid marbles and, more importantly, they can sustain both positive and negative pressure differences. This magnified strength is shown to originate from the strong cohesive nature of the shell. Those interesting properties could be exploited for imprisoning valuable or polluted gases or for designing new aerated materials.