Researchers develop a way to cause static self-assembly using magnets and ferrofluids

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A team of researchers at Finland's Aalto University has discovered a way to cause droplets of ferrofluid (liquids with suspended magnetic nanoparticles in them) to self-assemble into complex shapes. In their paper published in the journal *Science*, the team describes how they discovered that placing and moving a magnet under a ferrofluid sitting on a hydrophobic (water resistant) surface caused the fluid to separate and self-assemble into complex patterns.

Scientists are eager to find ways to cause self-assembly of synthetic structures because it would allow for the creation of materials at a lower cost—by eliminating the manual steps required to construct them. Prior research has revealed that there are many instances of self-assembly in nature—self-warping proteins are one example—but thus far it's been difficult to find reproducible ways to cause self-assembly in the lab. In this new effort, the team in Finland set a single drop of ferrofluid onto a hydrophobic surface and then moved a magnet beneath it to cause changes in its shape.

The team first tested moving the magnet closer to the underside of the surface to see what impact it would have on the drop—it coalesced with portions of it rising up off the surface, creating a three dimensional, pointy drop. Moving the magnet closer caused the drop to spontaneously split apart into several smaller drops. Moving even closer caused the smaller drops to split, resulting in many small drops, all still pointing skyward. Next, the team tried moving the magnet back and forth. The oscillation caused some of the drops to merge and as they did so, to form

into seemingly random shapes. Changing the oscillation rate caused the drops to form into different shapes. Removing the magnet caused each of the drops to return to a flattened state.

The researchers suggest their results might be useful going forward as a platform for discovering new ways to create self-assembled materials—by adding material to the drops that causes it to hold its shape after the magnet is removed. They also note that the their technique allows for separating a liquid very easily into several smaller drops—something that might prove very useful for such applications as running several tests on a single water sample at wastewater treatment plants.

More information: *Science*, doi:10.1126/science.1233775