

Exploring Materials— Ferrofluid

Can a liquid be magnetic?



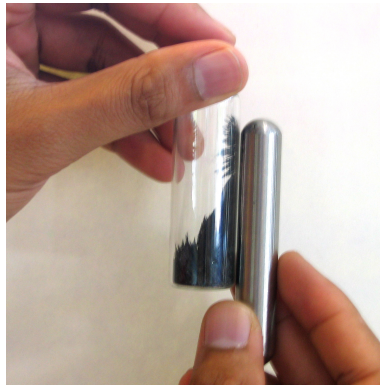
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Try this!

1. Hold a magnet next to the vial of black sand. How does the sand react?
2. Use the magnet to drag the sand up the sides of the vial. What happens when you remove the magnet?
3. Now try the same things with the vial of ferrofluid. Does the ferrofluid act the same way the sand does?



What's going on?

Ferrofluid is a unique material that acts like a magnetic solid *and* like a liquid. In contrast, black sand is a regular magnetic solid. Surprisingly, both ferrofluid and black sand are made of magnetite! The difference in their behavior is due to size.

Ferrofluid is made of tiny, nanometer-sized particles of coated magnetite suspended in liquid. When there's no magnet around, ferrofluid acts like a liquid. The magnetite particles move freely in the fluid. But when there's a magnet nearby, the particles are temporarily magnetized. They form structures within the fluid, causing the ferrofluid to act more like a solid. When the magnet is removed, the particles are demagnetized and ferrofluid acts like a liquid again.

Black sand is also made of magnetite, but it doesn't have ferrofluid's unusual properties. That's because the grains of sand are much larger than the magnetite particles in ferrofluid. As a result, they're permanently magnetic and can't be suspended in a liquid.

How is this nano?



Inside a hard drive

A material can act differently when it's nanometer-sized. (A nanometer is a billionth of a meter.)

On the nanoscale, magnetite is *paramagnetic*, meaning that it's magnetic only in the presence of a magnet. But on the macroscale, magnetite is permanently magnetic.

Nanotechnology takes advantage of special properties at the nanoscale—such as paramagnetism—to create new materials and devices.

Ferrofluid is used in rotary seals in computer hard drives and other rotating shaft motors, and in loudspeakers to dampen vibrations. In medicine, ferrofluid is used as a contrast agent for magnetic resonance imaging (MRI). In the future, ferrofluids may also be used to carry medications to specific locations in the body.

