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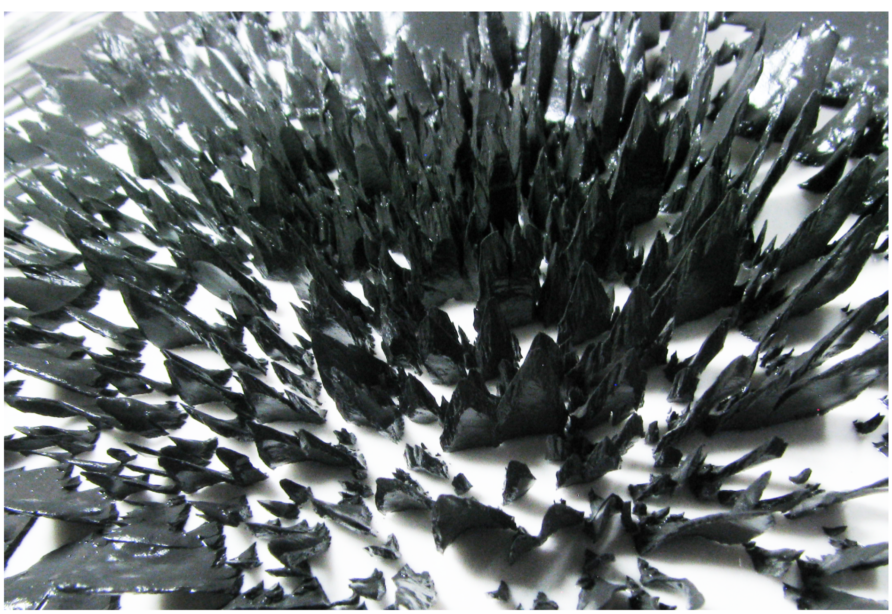
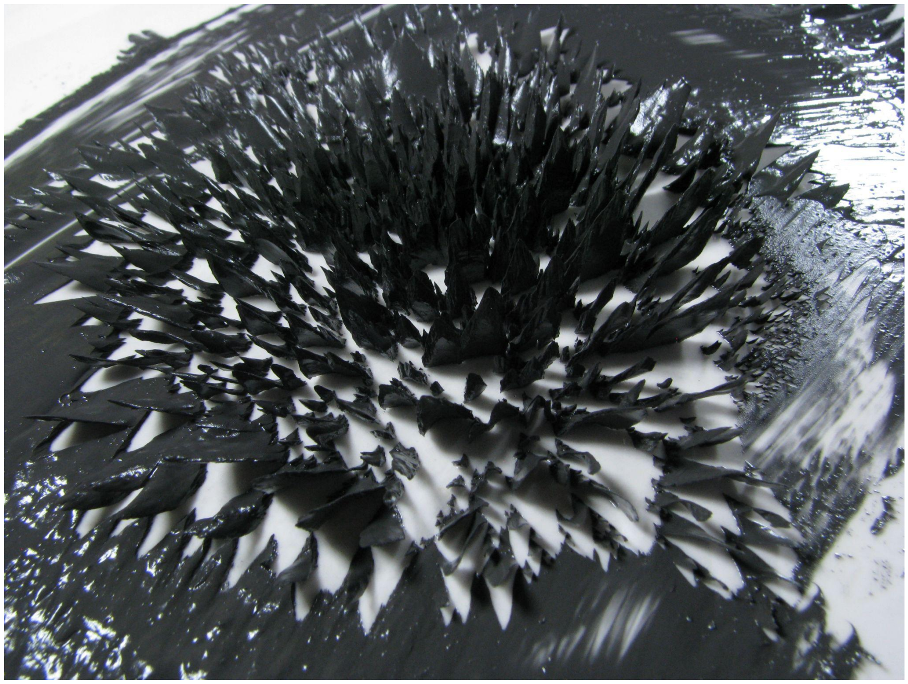
For this project we used magneto-rheological fluid and a high-powered magnet, causing the fluid to stand very rigidly in many exciting formations. Magneto-rheological fluid is often used in different automotive applications, as it stiffens up and becomes very viscous when exposed to a magnetic field. The fluid is used in brakes and clutches, as well as in safety features within commercial and military helicopters in the event of a crash, and even human prostheses[1]. Using the dark fluid and a glossy white background our group captured some great and varied shots. When doing our experiment, we were under the impression that we were using ferrofluid, which is a slightly different kind of magnetic-field-reactive fluid, but we still got some awesome pictures with the unique substance.

We sourced our magneto-rheological fluid from professor Hertzberg's personal stash and got the magnet from the ITLL's electronic center. Using a plate to hold the fluid on top of it, we manipulated it by placing the very strong magnet under the table the plate was on. The fluid under a magnetic field results in a normal field instability[2] which can be observed in the high valleys and peaks within the image. Though the shapes and sizes of each spire vary throughout our groups photos, the peaks and valleys caused by the phenomenon are a constant occurrence. The original and final image can be seen below.



Edited



Original

The fluid stiffens a lot because of the magnet which can be seen in the very rigid plate-like structures. The peaks and valleys result in stark contrast between the “rocky” black fluid and the smooth white plate. The significant difference in size between some of the formations which are very tiny and towards the center seems to be due to the increased cohesion and surface tension between the particles when compared to typical ferrofluid.

The field of view is approximately four inches by four inches since the shot was taken at about a 60 degree angle. The shot was captured using a Canon Powershot S5 IS digital camera, its lens having a focal length of 38 mm, and the camera was about 3.5 inches away from the subject. The image was taken in JPG format with the original dimensions of 3264x2448 px. The image was then cropped and edited to a 3262x1405 px PNG file. The image was taken in JPG format with the original dimensions of 3264x2448 px. The image was then cropped and edited to a 2159x1458 px PNG file. The image was taken with an f-stop of f/5.6, exposure time of 1/100th of a second, and ISO setting of 200. No flash was used for this image, the natural light coming into the room was abundant enough. The image’s contrast and brightness were adjusted, to create a more dramatic tone, as well as the frame and size.

I loved getting to experiment with the magneto-rheological fluid and thought everyone in our group ended up with a super fun shot. It was really amazing to see 4 very different takes on the same setup and essentially the same physics. In the future I look forward to being able to experiment with more of the fluid, as well as ferrofluid, it was a super unique and interesting experience.

Sources

[1] https://en.wikipedia.org/wiki/Magnetorheological_fluid#Aerospace

[2] https://www.nature.com/articles/s41598-017-02610-6