CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Harold F. Smith

Project Number
J1235

Project Title
An External Magnetic Field Temporarily Changes the Conductivity of a Ferrofluid: A Novel Effect

Abstract

Objectives/Goals
This study examined the effect of an external magnetic field on the conductivity of a Fe(3)O(4) ferrofluid.

Methods/Materials
A ferrofluid was prepared using the published UCLA protocol. The conductivity of the fluid was measured indirectly, using an Ohm meter to measure resistance. With the Ohm meter in place, a magnet was moved under the tray containing the ferrofluid. The resistance was recorded every 10 seconds for 2 minutes. Then the magnet was removed and the resistance was recorded every 10 seconds for 2 minutes. This process was repeated 3 times.

Results
The ferrofluid was slightly conductive. Moving a magnet under the ferrofluid caused the conductivity to increase. Over the period of two minutes, the conductivity returned to normal with the magnet still in place. Upon removal of the magnet, the conductivity decreased below the starting value. Again, this change returned to normal in two minutes.

Conclusions/Discussion
There are two unexpected aspects of the results. I expected that the conductivity would change, but I expected that it would be permanent once the nanoparticles realigned due to the influence of the magnetic field.

The first unexpected aspect was that the conductivity returned to the starting value with the magnet still in place. The second unexpected aspect was that the conductivity decreased below the baseline when the magnet was removed. That decreased conductivity also returned to the starting value in time.

Conductivity is caused by free ions in solution. How could these ions be affected by the arrangement of the nanoparticles? How could the change return to normal? Why does it take minutes to happen? Literature searches and discussions with Nanoscience researchers at UCLA have not yielded a satisfactory explanation for these observations.

Summary Statement
Addition or removal of a magnetic field on a ferrofluid causes a surprisingly temporary change in conductivity.

Help Received
Dad helped me collect the Ohm meter readings and helped make some of the ferrofluid. Mom helped me type and prepare the poster. The meters were borrowed from my dad and the chemicals were given to us by UCLA.