

Ferrofluids

Ferrofluid - a colloidal suspension of magnetic nanoparticles, typically magnetite, in a liquid medium such as paraffin oil or water

Colloid - a dispersion of particles from ~1 nm to 1000 nm in size and suspended in a fluid

Magnetite - the name of the compound, Fe_3O_4

Properties of ferrofluids

1. Magnetism - a force that can act at a distance between two materials due to properties of their electrons' spin and orbital motions

Ferrimagnetism - a phenomenon in which the internal magnetic moments of multiple spin sets of unpaired electrons within the domain of the solid do not completely cancel and therefore leave a net spin

Ferromagnetism - a phenomenon in which the internal magnetic moments of unpaired electrons within a domain of the solid are aligned and act cooperatively

2. spike - a pattern of uplifted particles that results from placing a magnet near the ferrofluid

3. they don't stick together

Why?

A surfactant has been added

Surfactant - a molecular substance or salt that surrounds particles and isolates them from the attractive forces of their neighbors

4. Why aren't the spikes permanent?

Individual particles of magnetite behave as tiny magnetic domains. Therefore, in the absence of a magnetic field and as a result of thermal agitation, the particles' magnetic domains become randomly oriented relative to one another.

Magnetic domain - regions where unpaired electrons strongly interact with one another and align even in the absence of a magnetic field

Unit Cells

Unit cell: a 3-D parallelepiped that, when shifted along each edge by the length of the edge, creates the entire structure of atoms in a crystal

See Appendix A Memory Metal and/or overheads

Holes- spaces created between ions or atoms in a crystal structure

For example, in magnetite there are holes formed by oxide ions - these holes provide various environments for the iron ions

What constitutes unit cells: Show examples

Parts of a unit cell

Corner atoms = $\frac{1}{8}$ atom per unit cell

Edges atoms = $\frac{1}{4}$ atom per unit cell

Face atoms = $\frac{1}{2}$ atom per unit cell

Inside atoms = 1 atom per unit cell

Atoms in the unit cell - a formula that indicates the actual number of atoms of each element in one unit cell of a crystalline solid

Empirical formula - information that gives the simplest ratio between the atoms of the elements present in a compound