Crystals and some uses…

Bone replacement crystals

Studies of the chemical composition of bones and tooth enamel were quite perplexing for the first researchers. These chemical compounds are very reactive nano-crystals known as *apatites*. By means of artificial biomineralization, Man has been able to **create crystalline prostheses which imitate nature.**

Crystals for pharmaceutical applications

The same molecule can crystallise in different forms while presenting the same chemical characteristics in solution. This **polymorphism** results from a different arrangement of molecules. In pharmacy, it is important to control the shape and size of the crystals that contain the active molecule of the medicine, because these parameters may influence the **dissolution rate** and thus have an effect on the effectiveness of the medicine.

Crystals and their defects in metallurgy

Metallurgy is the study of metals, intermetallic compounds and mixtures known as alloys. Metals and alloys are made up of many crystals and are *polycrystalline* solids. They have numerous uses ranging from steel in construction, to complex alloys used in modern jet engines, to coating that confer corrosion resistance. Even if hardness can be associated with certain structures, it is often the **defects in metals and alloys that determine their very useful mechanical properties**.

Liquid crystals!

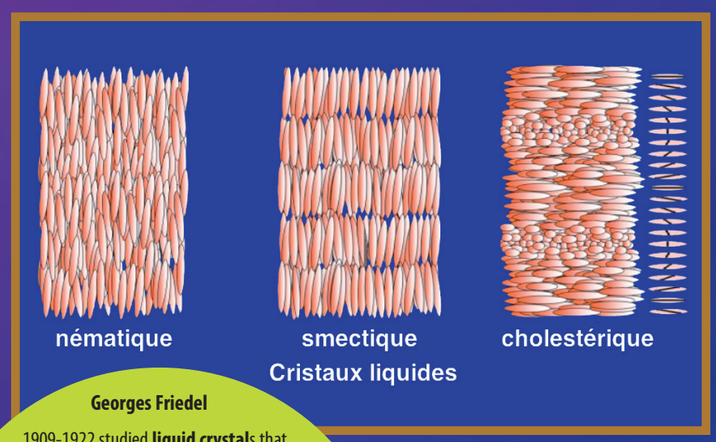
A liquid crystal is a **phase between the liquid and the solid state**: it flows like a liquid but has the properties of a solid. The molecules of a liquid crystal are highly elongated and have the tendency to line up like matches or cigars in a box. They owe their name to their optical properties which are similar to those of regular crystals.

Metallurgy :

From the Bronze Age to the "golden" age of steel

This science seeks to control the chemistry of metals and alloys, it studied their structures and properties, it also refers to the technologies of their manufacture, processing and shaping. The first traces of metallurgy date back to the use of bronze 5000 years ago in the Middle East. Around 1200 BC , it was discovered in Anatolia that when iron is heated with charcoal it becomes harder than bronze. It was not until the early 19th century that new metals such as aluminium were isolated. Many advances in the treatment of ferrous metals made this century the "golden age" of steel that contains iron with some carbon.

Knife Danakil Ethiopia © Coll. Natural History Museum of Grenoble



Georges Friedel

1909-1922 studied **liquid crystal**s that can produce stunning images ...

He classified them into three types:
- *Nematic*: the molecules are aligned but disorganized,
- *Smectic*: The aligned molecules form layers,
- *Cholesteric*: the orientation of the molecules form a helix.

The orientation of the molecules can be controlled by an electric field. This property is what makes liquid crystals the essential component of flat screens for moving images and colours. Liquid crystals are also present in nature on the shells of beetles ...

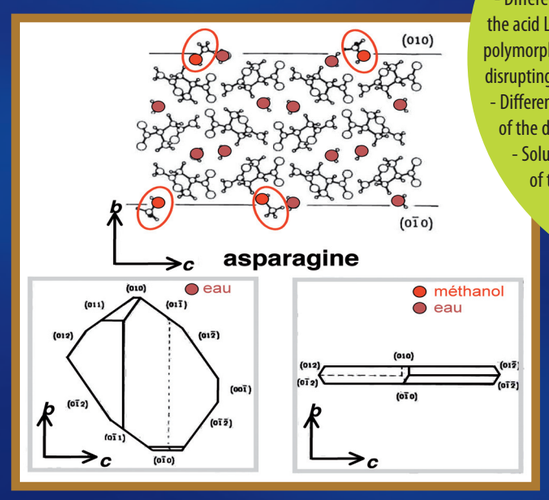
Source: University-IPCMS L. Pasteur -Strasbourg

Hip prosthesis.

© coll. Ecole des Mines de Saint-Etienne

How to mend broken bones?

Bone reconstruction in humans is difficult, sometime making use of surgical bone grafts is necessary. However, the difficulties associated with finding grafts from the patient, and the potential risks of viral transmissions raised by foreign transplants (human or animal), lead scientists to consider the creation of synthetic bone substitutes. Recent work shows the importance of biomaterials that influence bone growth and mineralization.



Polymorphysm of Asparagine

Polymorphism of crystals gives them distinct properties that may be important in pharmacy:
- Different distributions of faces of the crystals: for example, in the acid L-asparagine, certain solvents influence the formation of polymorphic forms, sticking onto one facet of growth without disrupting the assembly of molecules in the crystal
- Different density and porosity with consequences for the action of the drug.
- Solubility and dissolution rates modify the bioavailability of the drug with a risk of either under-dosing or toxicity.

Source: J. Doucet-LPS-Orsay

IYCr2014 Voyage dans le Cristal