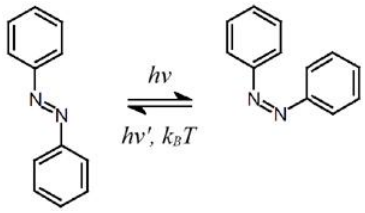
# 8.5: Chemistry in Physics

Chemistry has been defined as the science that is concerned with the composition, properties, and structure of matter and with the ways in which substances can change from one form to another. But this definition is too broad to be useful. Chemistry isn't the only science that deals with the composition and transformations of matter. Matter is also composed of quarks, which transform by annihilation, of metals which transform by annealing, and of stars which may transform by supernovae. These are normally considered the subject of Physics. Chemists are unique because they understand or explain everything, even the subjects studied by physicists, in terms of the properties of just over 100 kinds of atoms found in all matter, and the amazing variety of molecules that are created by forming and breaking bonds between atoms. ***So chemistry is defined by its approach, not its subject matter***. Chemistry explains or understands any subject in terms of the properties of atoms and molecules.

Chemistry provides a unique perspective that complements Physics in many areas of contemporary research.

For example, nanotechnology techniques have been applied to building “molecular motors”, artificial muscles, and molecular electronics. The action of these devices results from a change in shape of an azobenzene molecule (molecular shape and bonding tendencies are chemical properties) when it absorbs light. The molecule is bonded to a metal surface, so that the mechanical energy might be harnessed [1] as shown here[2]




The mechanical work can then be measured and characterized by standard methods of physics. In contrast to chemical properties, physical properties do not require explanations involving atoms or molecules; Physical properties include the ductility, density, or hardness of the metal used to anchor the molecular motors. These properties are easily defined and measured without reference to atoms.

Chemistry and Physics often complement each other in the development of new materials. Materials are often complex mixtures which do not have atoms in definite ratios. Chemically pure substances, like sulfuric acid, $H_2SO_4$ have specific atom ratios (2 H : 1S : 4 O in this case). Most materials (like cement, for example, which contains sand, lime, water, and other substances) are not considered chemicals, but mixtures. But atomic properties still are used to understand bonding between atoms in materials.

Although the Romans brought the secret of glassworking to Britain in 55BC, we still don't know what makes glass rigid as it cools and hardens. Now researchers [3] are beginning to understand how a rigid atomic structure takes shape as a glass is cooled. Normally, we thought glasslike materials just become more viscous as they is cooled. There are myths that glass windows are thicker at the bottom due to glass flow, but panes were probably just mounted that way by glaziers because it was thought to be good technique. The relationship between atomic structure and properties of solids, whether the blades of Japanese swords [4], the blades of turbines, or boron nitride cutting wheels, is a matter of intense interest to physicists and engineers. Once more, properties like rigidity that are quantified by physical methods are explained through the chemist’s attention to bonding between atoms or molecules.

Japanese swords[5]

**Important Terms:** Chemistry

Chemical

Chemical Property

Chemical Change, Reaction

From ChemPRIME: 1.0: Prelude to Chemistry

## References


1. ↑ Paul S. Weiss, James M. Tour in Nano Letters
2. ↑ en.Wikipedia.org/wiki/Azobenzene
3. ↑ http://www.sciencedaily.com/releases/2009/02/090206081511.htm
4. ↑ http://www.samurai-sword-site.com/Japanese-Sword-Making.html
5. ↑ en.Wikipedia.org/wiki/Japanese_sword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