A Dictionary of Chemistry

FIFTH EDITION

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became a professor at Berlin University in 1892. Here he formulated the *quantum theory, which had its basis in a paper of 1900. One of the most important scientific discoveries of the century, this work earned him the 1918 Nobel Prize for physics.

Planck constant Symbol *h*. The fundamental constant equal to the ratio of the energy of a quantum of energy to its frequency. It has the value 6.626 0755(40) × 10^{-34} J s. It is named after Max Planck. In quantum-mechanical calculations the *rationalized Planck constant* (or *Dirac constant*) $\hbar = h/2\pi = 1.054\,589 \times 10^{-34}$ J s is frequently used.

plane-polarized light *See* **polarization of light.**

plaster of Paris The hemihydrate of *calcium sulphate, $2CaSO_4.H_2O$, prepared by heating the mineral gypsum. When ground to a fine powder and mixed with water, plaster of Paris sets hard, forming interlocking crystals of gypsum. The setting results in an increase in volume and so the plaster fits tightly into a mould. It is used in pottery making, as a cast for setting broken bones, and as a constituent of the plaster used in the building industry.

plasticizer A substance added to a synthetic resin to make it flexible. *See* **plastics.**

plastics Materials that can be shaped by applying heat or pressure. Most plastics are made from polymeric synthetic *resins, although a few are based on natural substances (e.g. cellulose derivatives or shellac). They fall into two main classes. *Thermoplastic materials* can be repeatedly softened by heating and hardened again on cooling. *Thermosetting materials* are initially soft, but change irreversibly to a hard rigid form on heating. Plastics contain the synthetic resin mixed with such additives as pigments, plasticizers (to improve flexibility), antioxidants and other stabilizers, and fillers. See Chronology.

plastocyanin A blue copper-containing protein that is found in chloroplasts and acts as an electron carrier molecule in the light-dependent reactions of *photosynthesis. Plastocyanin consists of amino acid groups in association with a copper molecule which gives this compound a blue colour.

plastoquinone A quinone, found in chloroplasts, that functions as one of the carrier molecules of the electron transport chain in the light-dependent reactions of *photosynthesis.

platinum Symbol Pt. A silvery white metallic *transition element (*see also* **platinum metals**); a.n. 78; r.a.m. 195.09; r.d. 21.45; m.p. 1772°C; b.p. 3827±100°C. It occurs in some nickel and copper ores and is also found native in some deposits. The main source is the anode sludge obtained in copper–nickel refining. The element is used in jewellery, laboratory apparatus (e.g. thermocouples, electrodes, etc.), electrical contacts, and in certain alloys (e.g. with iridium or rhodium). It is also a hydrogenation

PLASTICS

1851	Scottish chemist Charles Macintosh (1766–1843) makes ebonite (from rubber).
1855	British chemist Alexander Parkes (1813–90) patents Parkesine, a plastic made from nitrocellulose, methanol, and wood pulp; it is later called 'celluloid'.
1860	British chemist Charles Williams (1829–1910) prepares isoprene (synthetic rubber).
1868	US printer John Hyatt (1837–1920) develops commercial process for making celluloid.
1884	French chemist Hilaire de Chardonnet (1839–1924) develops process for making rayon.
1892	British chemists Edward Bevan (1856–1921) and Charles Cross (1855–1935) develop the viscose process for making rayon.
1899	British chemist Frederick Kipping (1863–1949) discovers silicone plastics.
1901	German chemists Krische and Spitteler make formaldehyde–casein plastic (Galalith).
1905	Belgian-born US chemist Leo Baekland (1863–1944) invents Bakelite.
1912	Swiss chemist Jacques Brandenberger produces Cellophane (viscose cellulose film).
1913	US Formica Insulation company markets plastic laminate made from formaldehyde resins.
1918	Hans John prepares urea–formaldehyde resin.
1926	German chemist Hermann Staudinger (1881–1965) discovers the polymeric nature of plastics.
1930	US chemist Waldo Semon develops PVC (polyvinyl chloride).
1930	Canadian chemist William Chalmers discovers polymethylmethacrylate (Perspex and Plexiglass).
1930	German chemists at IG Farbenindustrie produce polystyrene.
1931	Wallace Carothers invents nylon.
1938	US chemist Roy Plunkett produces polytetrafluoroethene (PTFE).
1939	British company ICI develops commercial process for making polyethene.
1941	British chemists John Whinfield (1901–66) and J. Dickson develop Terylene (Dacron).
1941	German company IG Farbenindustrie produces polyurethane.
1943	US Dow Corning company produces silicone plastics.
1947	British chemists produce acrylic fibres.
1953	German chemist Karl Ziegler (1896–1973) discovers catalyst for making high-density polyethene.
1954	Italian chemist Giulio Natta (1903–79) develops industrial process for making high-density polyethene (using Ziegler catalyst).
1989	Italian company Ferruzzi produces biodegradable plastic (based on starch).

resin A synthetic or naturally occurring *polymer. Synthetic resins are used in making *plastics. Natural resins are acidic chemicals secreted by many trees (especially conifers) into ducts or canals. They are found either as brittle glassy substances or dissolved in essential oils. Their functions are probably similar to those of gums and mucilages.

resolution The process of separating a racemic mixture into its optically active constituents. In some cases the crystals of the two forms have a different appearance, and the separation can be done by hand. In general, however, physical methods (distillation, crystallization, etc.) cannot be used because the optical isomers have identical physical properties. The most common technique is to react the mixture with a compound that is itself optically active, and then separate the two. For instance, a racemic mixture of *l*-A and *d*-A reacted with *l*-B, gives two compounds AB that are not optical isomers but diastereoisomers and can be separated and reconverted into the pure *l*-A and *d*-A. Biological techniques using bacteria that convert one form but not the other can also be used.

resonance The representation of the structure of a molecule by two or more conventional formulae. For example, the formula of methanal can be represented by a covalent structure $H_2C{=}O$, in which there is a double bond in the carbonyl group. It is known that in such compounds the oxygen has some negative charge and the carbon some positive charge. The true bonding in the molecule is somewhere between $H_2C{=}O$ and the ionic compound $H_2C^+O^-$. It is said to be a *resonance hybrid* of the two, indicated by

$$H_2C{=}O \leftrightarrow H_2C^+O^-$$

The two possible structures are called *canonical forms*, and they need not contribute equally to the actual form. Note that the double-headed arrow does not imply that the two forms are in equilibrium.

resonance effect *See* **electronic effects.**

resonance ionization spectroscopy (RIS) A spectroscopic technique in which single atoms in a gas are detected using a laser to ionize that atom. A sample containing the atoms to be excited is subjected to light from a laser, tuned so that only that type of atom is excited by the light. If the frequency of light at which the atom is excited is ν, the atoms in the excited state can be ionized if the ionization potential of the atom is less than 2ν. In contrast to other techniques of ionization, this type of ionization only occurs for atoms that are 'in tune' with the frequency of light. Because RIS is very selective in determining which atom is ionized for a given frequency it has many applications in chemistry.

resorcinol *See* **1,3-dihydroxybenzene.**

retinol *See* **vitamin A.**

retort 1. A laboratory apparatus consisting of a glass bulb with a long neck. **2.** A vessel used for reaction or distillation in industrial chemical processes.