**Nuclear Chemistry**

**Sound Records**

**Sound Records:**

[Radioactivity](radioactivity.wav)

[Chemical Elements](file:///C:\Users\Cídlová\Desktop\hana\výuka\nuclear%20chemistry\Chemical%20Elements.wav)

[General Chemistry Vocabulary](file:///C:\Users\Cídlová\Desktop\hana\výuka\nuclear%20chemistry\words%20and%20phrases.wav)

**Brno 2014**

**Radioactivity**

Radioactivity was discovered in 1896 by the French scientist Henri Becquerel, while working on phosphorescent materials. These materials glow in the dark after exposure to light, and he suspected that the glow produced in cathode ray tubes by X-rays might be associated with phosphorescence. He wrapped a photographic plate in black paper and placed various phosphorescent salts on it. All results were negative until he used uranium salts. The result with these compounds was to cause a blackening of the plate in spite of the plate being wrapped in black paper. These radiations were given the name "Becquerel Rays".

It soon became clear that the blackening of the plate had nothing to do with phosphorescence, as the plate recorded the presence of the mineral while wrapped and non-phosphorescent salts of uranium and metallic uranium also blackened the plate. It was clear that there was a form of invisible radiation that could pass through paper and was causing the plate to react as if exposed to light and so become black.

At first, it seemed as though the new radiation was similar to the then recently discovered X-rays. Further research by Becquerel, Ernest Rutherford, Paul Villard, Pierre Curie, Marie Curie, and others showed that this form of radioactivity was significantly more complicated. Rutherford was the first to realize that they all decay in accordance with the same mathematical exponential formula, and Rutherford and his student Frederick Soddy were the first to realize that many decay processes resulted in the transmutation of one element to another. Subsequently, the radioactive displacement law of Fajans and Soddy was formulated to describe the products of alpha and beta decay.

The early researchers also discovered that many other chemical elements, besides uranium, have radioactive isotopes. A systematic search for the total radioactivity in uranium ores also guided Pierre and Marie Curie to isolate two new elements: polonium and radium. Except for the radioactivity of radium, the chemical similarity of radium to barium made these two elements difficult to distinguish.

The dangers of radioactivity and radiation were not immediately recognized. The discovery of x‑rays in 1895 led to widespread experimentation by scientists, physicians, and inventors. Many people began recounting stories of burns, hair loss and worse in technical journals as early as 1896. In February of that year, Professor Daniel and Dr. Dudley of Vanderbilt University performed an experiment involving x-raying Dudley's head that resulted in his hair loss. A report by Dr. H.D. Hawks, a graduate of Columbia College, of his suffering severe hand and chest burns in an x-ray demonstration, was the first of many other reports in *Electrical Review*. Many experimenters including Elihu Thomson at Thomas Edison's lab, William J. Morton, and Nikola Tesla also reported burns. Elihu Thomson deliberately exposed a finger to an x-ray tube over a period of time and suffered pain, swelling, and blistering. Other effects, including ultraviolet rays and ozone were sometimes blamed for the damage. Many physicians claimed that there were no effects from x-ray exposure at all.

# Before the biological effects of radiation were known, many physicians and corporations began marketing radioactive substances as patent medicine in the form of glow-in-the-dark pigments. Examples were radium enema treatments, and radium-containing waters to be drunk as tonics.Marie Curie protested against this sort of treatment, warning that the effects of radiation on the human body were not well understood. Curie later died from aplastic anaemia, likely caused by exposure to ionizing radiation. By the 1930s, after a number of cases of bone necrosis and death of radium treatment enthusiasts, radium-containing medicinal products had been largely removed from the market (radioactive quackery).

# Chemical Elements

Actinium

Aluminium

Aluminum

Americium

Antimony

Argon

Arsenic

Astatine

Barium

Berkelium

Beryllium

Bismuth

Bohrium

Boron

Bromine

Cadmium

Caesium

Calcium

Californium

Carbon

Cerium

Cesium

Chlorine

Chromium

Cobalt

Copernicium

Copper

Curium

Darmstadtium

Dubnium

Dysprosium

Einsteinium

Erbium

Europium

Fermium

Flerovium

Fluorine

Francium

Gadolinium

Gallium

Germanium

Gold

Hafnium

Hassium

Helium

Holmium

Hydrogen

Indium

Iodine

Iridium

Iron

Krypton

Lanthanum

Lawrencium

Lead

Lithium

Livermorium

Lutetium

Magnesium

Manganese

Meitnerium

Mendelevium

Mercury

Molybdenum

Neodymium

Neon

Neptunium

Nickel

Niobium

Nitrogen

Nobelium

Osmium

Oxygen

Palladium

Phosphorus

Platinum

Plutonium

Polonium

Potassium

Praseodymium

Promethium

Protactinium

Radium

Radon

Rhenium

Rhodium

Roentgenium

Rubidium

Ruthenium

Rutherfordium

Samarium

Scandium

Seaborgium

Selenium

Silicon

Silver

Sodium

Strontium

Sulphur

Tantalum

Technetium

Tellurium

Terbium

Thallium

Thorium

Thulium

Tin

Titanium

Tungsten

Ununoctium

Ununpentium

Ununseptium

Ununtrium

Uranium

Vanadium

Xenon

Ytterbium

Yttrium

Zinc

Zirconium

# General Vocabulary

absorbance

absorption of radiation

electron affinity

actinides

α-helix

aluminosilicate

volumetric analysis

gravimetric analysis

aniline

antiparticle

activation barrier

baryon

soft base

hard base

benzene

protein

biochemistry

stationary point

borane

boson

intermediate boson

butadiene

reaction path

α particle

β particle

particle of force field

atomic number

Avogadro´s number

quantum number

principal quantum number

magnetic quantum number

orbital angular momentum quantum number

mass number

proton number

degenaracy of state

bond lenght

wavelength

derivative

deuterium

diffusion

dissociation

particle-wave duality

nonadiabatic effect

electrolyte

strong electrolyte

weak electrolyte

elektrolysis

electron

electronegativity

emission of radiation

energy

activation energy

total energy

discrimination energy

dissociation energy

photon energy

Gibbs (free) energy

standard Gibbs energy

Helmholtz energy

kinetic energy

zero-point energy

orbital energy

potential energy

potential energy curve

vibrational energy

internal energy

enthalpy

enthalpy of reaction

standard enthalpy of formation

entropy

enzyme

ethylene

fermion

fluidity

fluorescence

phosphorescence

photon

collision frequency

frequency of radiation

function

state function

wave function

symmetry properties of wave function

electron wave function

nuclear fusion

gene

geometry of molecule

graphite

graviton

group

point group

hadron

Hamiltonian

helium

atomic mass

molecular mass

electron density, distribution

probability density

(linear) momentum

hybridization

potential energy hypersurface

analytical chemistry

inorganic chemistry

physical chemistry

organic chemistry

chirality

chromatography

chromosome

angular momentum

genetic information

graphical integration

numerical integration

integral

indefinite integral

constant of motion

overlap integral

definite integral

Coulomb interaction

electromagnetic interaction

gravitational interaction

strong interaction

weak interaction

hydrogen molecular ion

insulator

isomer

atomic nucleus

carcinogenic activity of hydrocarbons

heat capacity

catalysis

acid catalysis

hydronium cation

cluster

molar absorption coefficient

expansion coefficient

activated complex

transition complex

charge-transfer complex

electron configuration

dissociation constant

Planck constant

(universal) gas constant

equilibrium constant

rate constant

energy continuum

reaction coordinate

ionic crystal

liquid crystal

covalent crystal

molecular crystal

potential-energy curve

quantization

quantization of energy

quark

deoxyribonucleic acid

soft acid

nucleic acid

hard acid

lanthanides

laser

amorphous solids

crystalline solids

lepton

ligand

classical mechanics

statistical mechanics

donor-acceptor mechanism

reaction mechanism

metallocene

metalloid

reaction intermediate

meson

muon

amount of substance

antibonding MO

bonding MO

cyclic molecule

molecularity of reaction

angular momentum

orbital angular momentum

magnetic moment

transition moment

spin multiplicity

naphtalene

nonmetal

indistinguishability of particles

neutralization

neutrino

neutron

nucleoside

nucleotide

nuclide

molar volume

inversion (operation)

symmetry operation

operator

Hamilton operator (Hamiltonian)

Laplace operator (Laplacian)

atomic orbital

hybrid orbital

molecular orbital

unoccupied (virtual) orbital

occupied orbital

valence orbital

π orbital

δ orbital

σ orbital

symmetry axis

electron pair

absorption band

energy band

valence band

conduction band

period (row) of elements

permittivity (dielectric constant)

pH, measure of acidity

ideal gas

real gas

synthesis gas

noble gas

boundary condition

initial condition

computational experiment

polarography

half-life for radioactive decay

semiconductor

bathochromic shift

hypsochromic shift

ionization potential

positron

Hund rule

rule of maximum multiplicity

selection rule

Heisenberg uncertainty principle

building-up (Aufbau) principle

principle of equipartition of energy

Pauli exclusion principle

absorption process

adiabatic process

emission process

irreversible process

reversible process

product of reaction

ion product constant of water

proton

transition element

symmetry element

spectral transition

pyridine

radical

induced radioactivity

spontaneous radioactivity

bimolecular reaction

endothermic reaction

exothermic reaction

photochemical reaction

monomolecular (unimolecular) reaction

first-order reaction

reduction-oxidation reaction

kinetically controlled reaction

thermodynamically controlled reaction

trimolecular (termolecular) reaction

reactant

reduction

Coulomb repulsion

rotation

Clausius-Clapeyron equation

differential equation

equation of state for the ideal gas

van der Waals equation

acid-base equilibrium

catalytic decomposition

radioactive decay

reaction rate

decay rate

velocity of light

reaction order

orbital scheme

state scheme

intermolecular forces

physical state

group of elements

conjugated compound

nonstoichiometric compound

electron shell

closed shell

solvolysis

spectrometer

mass spectrometry

infrared spectroscopy

microwave spectroscopy

electronic spectrum

rotational spectrum

vibrational- rotational spectrum

spin

elastic collision

inelastic collision

reactive collision

electronic state

liquid state

quantum state

state of a substance

solid (state)

gaseous state

resonance phenomenon

rotational state

equilibrium

singlet state

stationary state

standard state

excited state

ground state

stoichiometry

molecular structure

centre of symmetry

degree of degeneracy

vibrational degree of freedom

superconductivity

symmetry

nuclear fission

Bohr theory

quantum theory

collision theory

heat

heat of sublimation

heat of vaporization

absolute (Kelvin) temperature

thermodynamics

chemical thermodynamics

thiophene

system trajectory

tritium

mass defect

dihedral angle

bond angle

aliphatic hydrocarbon

alternant hydrocarbon

cyclic hydrocarbon

saturated hydrocarbon

nonalternant hydrocarbon

unsaturated hydrocarbon

double bond

chemical bond

peptide bond

triple bond

hydrogen bond

vibration

vibration of a bond

viscosity

extensive property

intensive property

conductor

electron shell

Einstein relation

weakon

Hess law

Lambert-Beer law

Maxwell-Boltzmann energy-distribution law

law of conservation of energy

electromagnetic radiation

zeolite

reflection