Bio-Physical Aspects of Somatoinfra Phenomenon and Somatoinfra®© Technology

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1. Introduction and background information

Somatoinfra®© is a novel, patented technology developed primarily for non-invasiv"e, in situ detection and analysis of functional anatomic processes in human body (Ref.1).

(Ref. 1. Patent)

The Somatoinfra®© technology development is based on previous research initiated by Michael Szacsky in the laboratories of the Budapest Technical University MTSE (Ref 2.)

The Somatoinfra®© technology is developed within the context of the so called "trilogy theory" by Szacsky (Ref.3).

The three essential parts of the trilogy theory are the followings:

1. Biological "aperiodic ion lattice" (AIL) theory
2. Biological half-life (BHL) theory
3. Functional anatomy imaging based on Somatoinfra ther 3.

According to the 3rd. part of the trilogy theory, the detection of Somatoinfra light gives a unique opportunity to investigate functional anatomic processes in a non-invasive way and obtain instant, "in situ" information about the health status of many important parts and organs within the human body.

The application of functional anatomic imaging, based on Somatoinfra®© technology its significant potential in health screening programmes was described in the Second WHO Global forum on medical Devices (Ref. 3.)

This paper describes some fundamental theoretical considerations (based on physics and biochemistry) associated with the Somatoinfra light emission.

2. Somatoinfra light range used for detection

The Somatoinfra technology is based on detection and analysis of infrared light peaks emitted from the human body, within the spectral range from 8.4 μm to 9.6 μm. These infrared light peaks are very sharp, their half widths are less than 0.01 μm.

It is important to emphasize that the infrared light peaks emitted in his range are **not associated** with the blackbody radiation of the temperature of the human body.

The healthy human body has an average temperature, ranging from 36.6 C to 37.2 C (309.6 K to 310.2 K), depending on the type, the physiological state for a given person and also the local environmental conditions (temperature, humidity etc.).

The energy E of this temperature range can be calculated by the Boltzmann equation:

$$E = kT \qquad (1)$$

where k is the Boltzmann constant and T is the absolute temperature (in Kelvin).

According to eq. 1, this temperature range (from 36.6 C to 37.2 C) has an energy range of 0.026679 eV to 0.026731 eV.

On the other hand, this temperature (energy) range is also associated with a photon frequency (from 6.451 THz to 6.4635 THz) and wavelength (from 46.472 µm 46.382 µm) range of light (photon energy), according to the Planck formula:

$$E = hc / \lambda \qquad (2)$$

where h is the Planck constant, c is the speed of light (photon), ν is the frequency of the light (photon) and λ is the wavelength of the light (photon).

It is important to emphasize, that wavelengths (8.4 µm to 9.6 µm) for Somatoinfra light detection are much shorter and the corresponding energies (0.13776 eV to 0.1476 eV) are much larger than expected from the black body radiation of a human body within the normal temperature range.

Table I. describes the fundamental characteristics for the Somatoinfra light (photons) within the experimentally observed photon energy range (calculated from the Planck law).

Photon wavelength (μm)	Photon frequency (THz)	Photon energy (eV)	Photon energy (kJ/mol)	Photon energy (kcal/mol)	Photon temperature (K)
8.4	35.69	0.1476	14.241	3.4037	1712
9	33.31	0.1377	13.292	3.1768	1598
9.6	31.23	0.1292	12.461	2.9873	1498

These photon energies and photon temperatures are about five times larger than can be calculated from the theory of black body radiation described by Wien's displacement law. Also, it should be emphasized, that Somatoinfra light peaks are very sharp (their half width is less than 1 mK or 0.01 μm , while the infrared radiation due to the black body radiation of humans (related to the average temperature of the human body has a much wider spectral range (covering several μm -s).

In short, the Somatoinfra light peaks are detected as sharp peaks emerging from black body infrared radiation background of the human body.

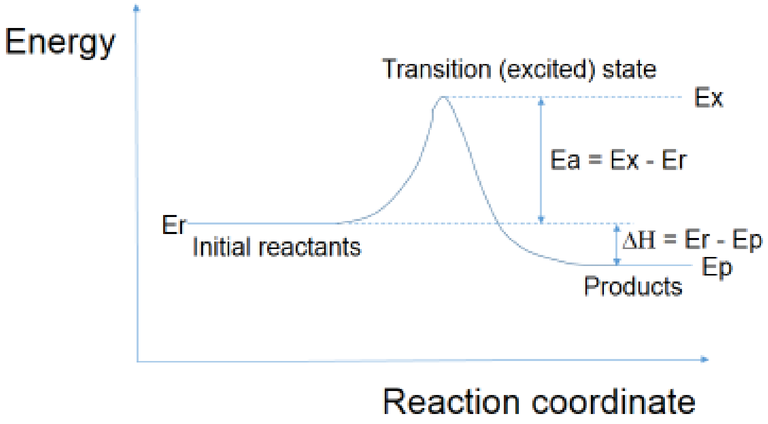
It can be seen from Table I. that the wavelengths (8.4 μm to 9.6 μm) for Somatoinfra light detection are much shorter and the corresponding energies (0.13776 eV to 0.1476 eV) are much larger than expected from the black body radiation of a human body within the normal temperature range.

Wien's displacement law states that the wavelength distribution of thermal radiation from a black body at any temperature has essentially the same shape as the distribution at any other temperature, except that each wavelength is displaced on the graph. Apart from an overall T^4 multiplicatitheve factor, the average thermal energy in each mode with frequency ν only depends on the ratio ν/T. Restated in terms of the wavelength $\lambda = c/\nu$, the distributions at corresponding wavelengths are related, where corresponding wavelengths are at locations proportional to $1/T$. Blackbody radiation approximates to Wien's law at high frequency.

2. Origin of Somatoinfra light

We propose that the origin of the Somatoinfra light emission can be explained within the context of the “trilogy theory” suggested by Szacsky (Ref.2). The trilogy theory has three basic statements as follows:

We propose that the Somatoinfra light peaks detected in the 8.4 □m to 9.6 □m infrared light range are associated with photons created and released in organic exothermic reactions within the human metabolism cycle.



Energy diagram describing the schematics of an exothermic chemical reaction.

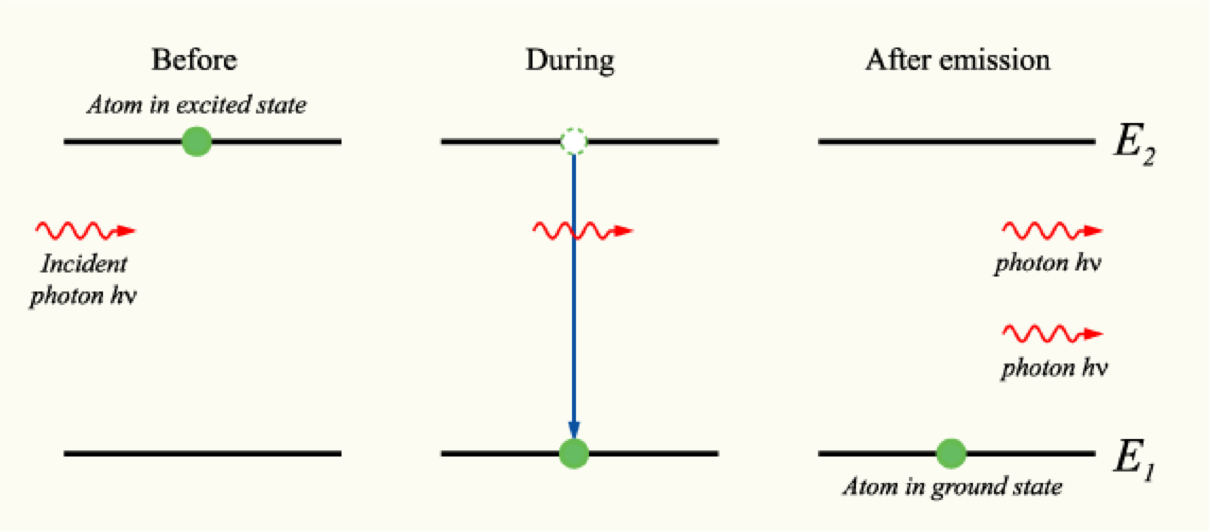
When two molecules react, first they create an initial (excited state) and the final products are formed after a relaxation from the excited state. If the total energy of the initial reactant molecules (Er) is higher than the total energy of the product molecules (Ep), the reaction is exothermic i.e. releases energy in the form of heat or light. The value of the released energy corresponds to the enthalpy difference (($\Delta H = Er - Ep$).

The energy can be released in the form of heat or light (luminescence).

Since vibrational energy is generally much greater than the thermal agitation, it rapidly disperses in the solvent through molecular rotation. This is how exothermic reactions make their solutions hotter.

Chemoluminescence is the emission of light (luminescence), as the result of a chemical reaction. In a chemiluminescent reaction, the direct product of a reaction is an excited electronic state, which then decays into an electronic ground state through either fluorescence or phosphorescence, depending partly on the spin state of the electronic excited state formed.

The decay of the excited state to a lower energy level causes light emission. In theory, one photon of light should be given off for each molecule of reactant (quantum efficiency = 1). This is equivalent to Avogadro's number of photons per mole of reactant. In actual practice, different chemical reactions have different quantum efficiencies.



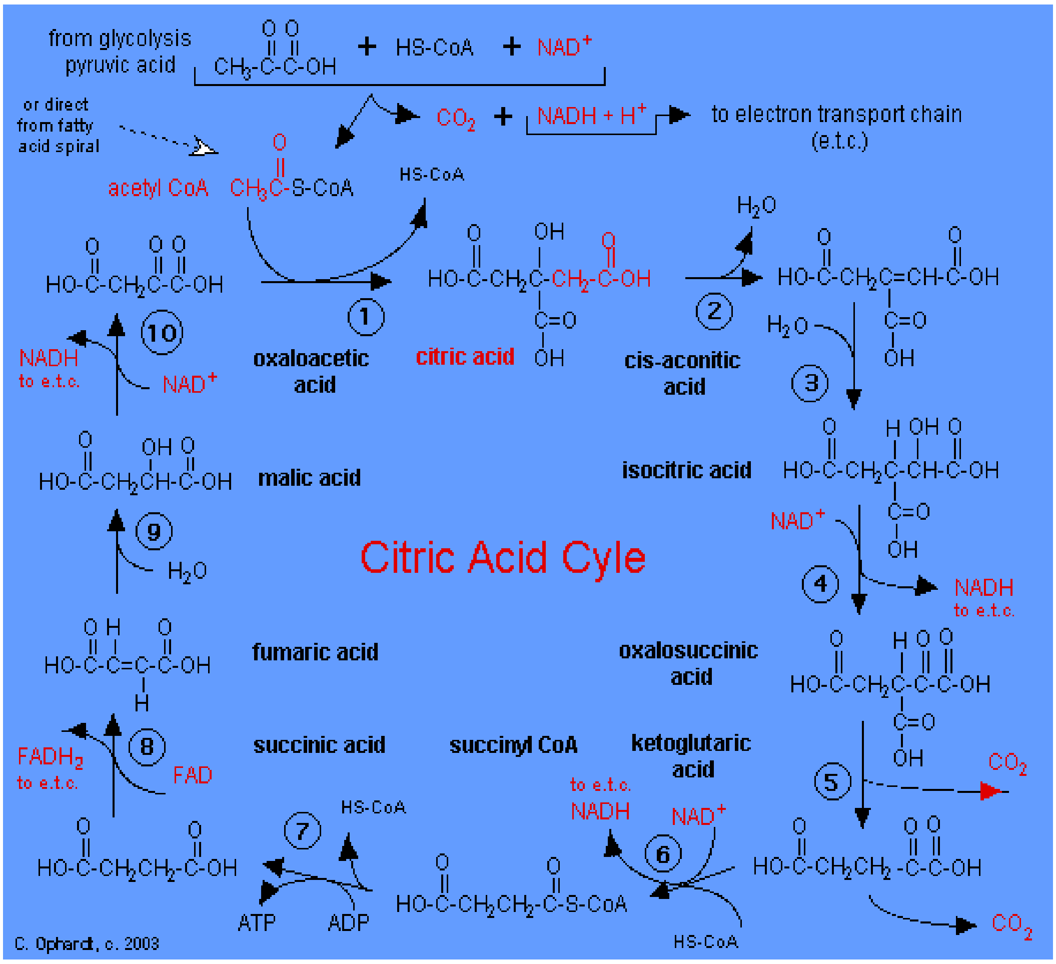
Schematical figure describing the light emission due to exctitation, and relaxation of the excited state. If the excitation is caused by an absorbed incident photon, the resulting light is created by photoluminescence. If the excitation is caused by heat from a chemical reaction, the resulting light is created by chemoluninescence.

The Somatoinfra light detected in the spectral range from 8.4 μm to 9.6 μm corresponds to photon energies from 0.1291 eV to 0.1476 eV, equivalent of the energies released from the exothermic chemical reactions (from 12.461 kJ/mol to 14.241 kJ/mol).

In the followings we describe some possible exothermic chemical reactions within the metabolism cycle emitting the “appropriate photon energy values” for Somatoinfra light as described above. The metabolism provides the essential energy for the normal, healthy “operation” of the human body.

4. Exothermic reactions within the Krebs Cycle (Metabolism cycle)

The Krebs cycle refers to a complex series of chemical reactions that produce carbon dioxide and Adenosine triphosphate (ATP), a compound rich in energy. The cycle occurs by essentially linking two carbon coenzyme with carbon compounds; the created compound then goes through a series of changes that produce energy. This cycle occurs in all cells that utilize oxygen as part of their respiration process. Carbon dioxide is important for various reasons, the main one being that it stimulates breathing, while ATP provides cells with the energy required for the synthesis of proteins from amino acids and the replication of deoxyribonucleic acid (DNA); both are vital for energy supply and for life to continue. The Krebs cycle provides the major source of energy in all living organisms.



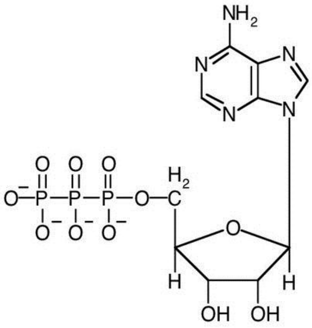
Schematical description of Citric acid (Krebs) cycle

From the point of view of energy considerations, the 10 major chemical reactions that constitute the Krebs cycle contain a series of endothermic (energy consuming) and exothermic (energy generating) reactions. The Somatoinfra light is generated via the exothermic reactions. In the followings, some of these reactions will be discussed.

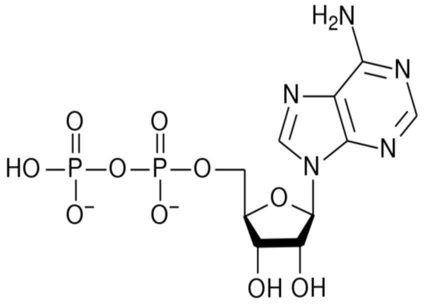
ATO to ADP (exothermic) reaction

Adenosine-5'-triphosphate (ATP) is comprised of an adenine ring, a ribose sugar, and three phosphate groups. ATP is often used for energy transfer in the cell. ATP synthase produces ATP from ADP or AMP + P_i. ATP has many uses. It is used as a coenzyme, in glycolysis, for example. ATP is also found in nucleic acids in the processes of DNA replication and transcription. In a neutral solution, ATP has negatively charged groups that allow it to chelate metals. It is important to emphasize the role of ions in stabilizing the ATO molecule within the living cell’s environment. Usually, Mg^{2+} stabilizes it.

ATP is an unstable molecule which hydrolyzes to ADP and inorganic phosphate when it is in equilibrium with water. The high energy of this molecule comes from the two high-energy phosphate bonds. The bonds between phosphate molecules are called phosphoanhydride bonds. They are energy-rich and contain an enthalpy ΔG of -30.5 kJ/mol.



ATP molecule



ADP molecule

Figure … Structure of ATP molecule and ADP molecule, respectively. The adenine ring is at the top, connected to a ribose sugar, which is connected to the phosphate groups.

Hydrolysis of ATP

Removing or adding one phosphate group interconverts ATP to ADP or ADP to AMP.

Breaking one phosphoanhydride bond releases 7.3 kcal/mol of energy.

ATP+H 2 O→ADP+P i ΔG = -30.5 kJ/mol

ATP+H 2 O→AMP+2P i ΔG = -61 kJ/mol

2ADP+H 2 O→2AMP+2P i ΔG = -61 kJ/mol

At pH 7,

ATP 4− +H 2 O⇌ADP 3− +HPO 2− 4 +H +

It can be seen that that the energy released via the ATP to ADP reaction (30.5 kJ) is slightly larger, but within the same order of magnitude as the energy range associated with the Somatoinfra light (13.29 kJ /mol to 14.24 kJ / mol). Therefore, ATP to ADP reactions or similar reactions might be associated with the emission of Somatoinfra light.

The ATP molecules are the single most important energy providers to maintain the operation of cells within our body. The human body consists of about one hundred trillion cells and in each cell, at any instant, there are about one billion ATP molecules.

However, these large number of ATP molecules can only provide energy to the cell for only a few minutes therefore they must be fast recycled. In order to achieve the normal energy supply to the cells, for each ATP molecules, the terminal phosphate group must be recycled 3 times a minute. This is the main task for the Krebs cycle! The molecules (and their energy) for maintaining the constant operation of the Krebs cycle is provided

by the food (and water) consumed every day (plus the oxygen from the air).

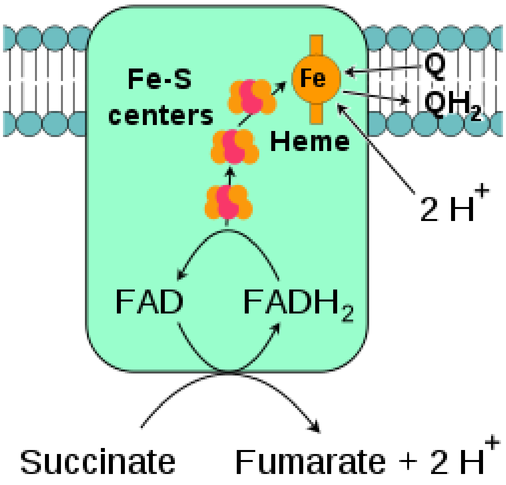
The human body contains about 50 gr of ATP which must be recycled every day.

The average intake of 2500 calories of food translates into a TURNOVER of 180 gr ATP per day !

Therefore, the operation of a human body is only possible if this huge and continuously operating cycle is maintained.

The Somatoinfra light is the consequence of exothermic reactions within the metabolism cycle, releasing photon energies in the infrared spectral range !

Other candidates for Somatoinfra light emission are the oxidative (exothermic steps) within the Krebs cycle. One of them for example the succinate to fumarate reaction (oxidative reaction) that is accompanied with the removal of two H atoms and two electrons from the succinate. This reaction is also exothermic and the photon energies released by this reaction is also close to the Somatoinfra energy range.



It is important to emphasize, that in this particular case, the role of Iron atoms (ions) is very important as these atoms are used to create an appropriate electrical potential along the reaction pathways to initiate and maintain atom (ion) transfers.

Propagation of Somatoinfra light within the human body

Light from a point like source (from the chemical reaction site) into the direction of Infrared detector outside of the human body (propagation into one direction).

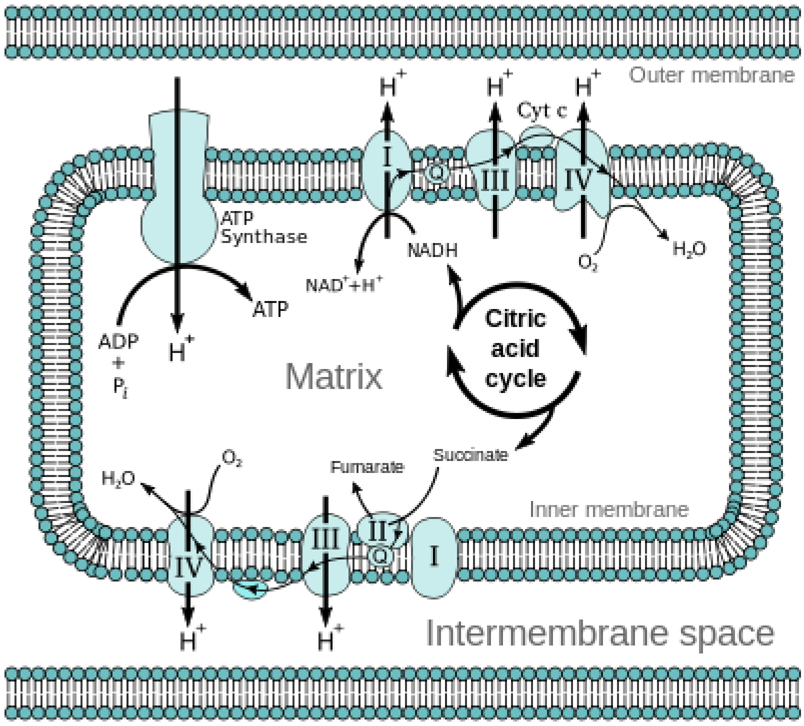
$Itr = Io - (Ir + Ia + Isc)$

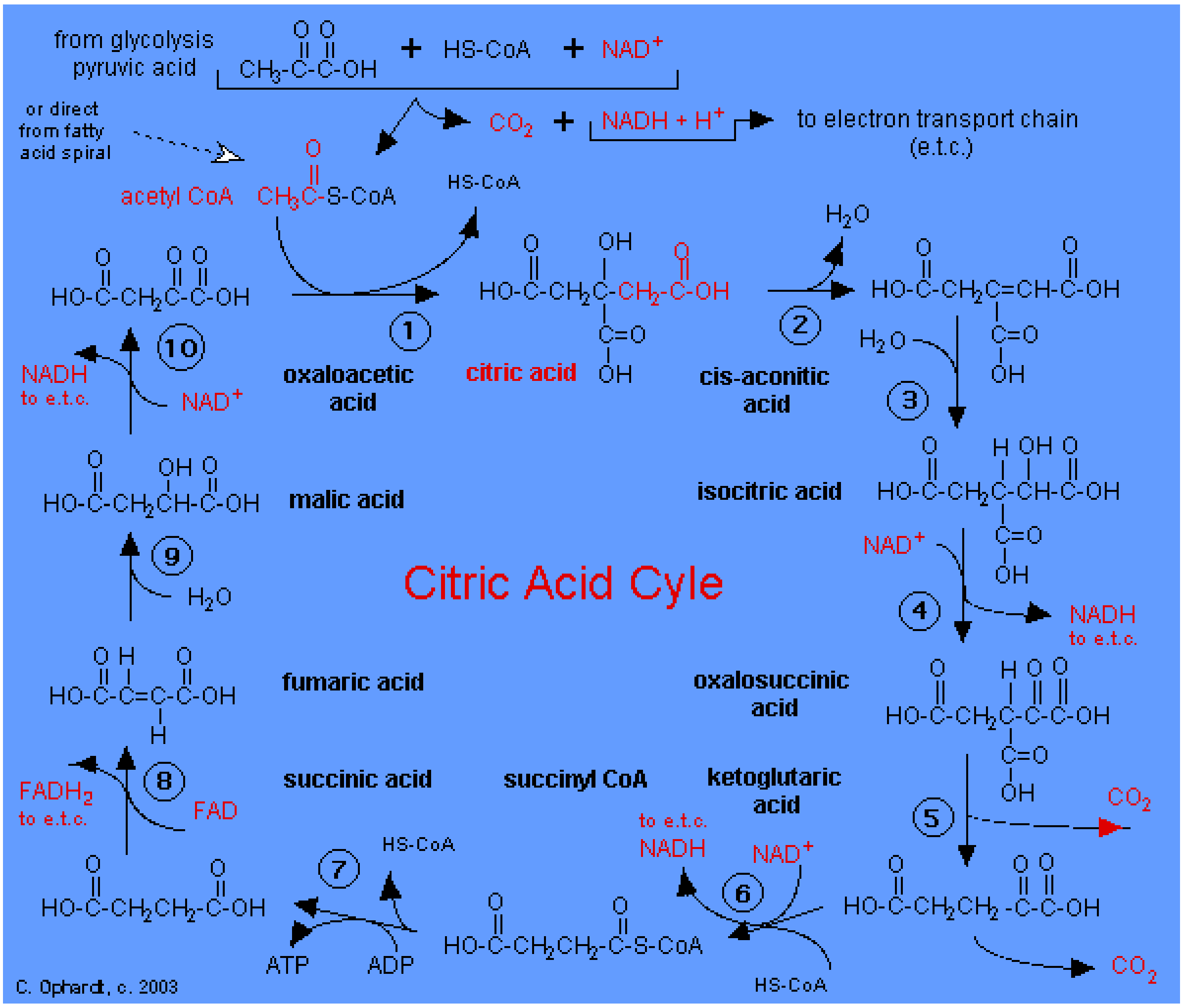
$Itr = Itro \exp (- \alpha d)$

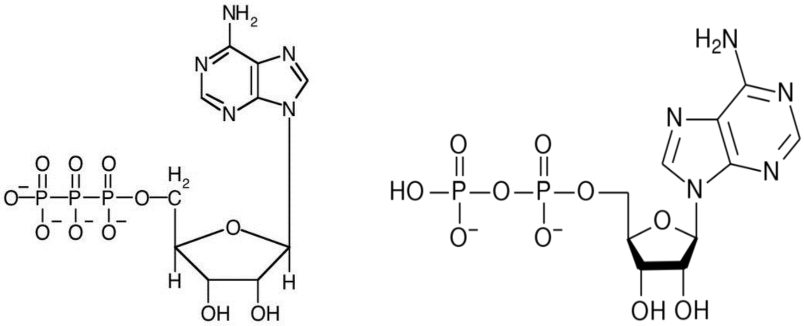
Detection of Somatoinfra light with bolometer technology

Analysis of Somatoinfra light using 3 dimensional spatial analysis

Metabolism within the cell







ATP structure ADP structure

Structure of ATP molecule and ADP molecule, respectively. The adenine ring is at the top, connected to a ribose sugar, which is connected to the phosphate groups.

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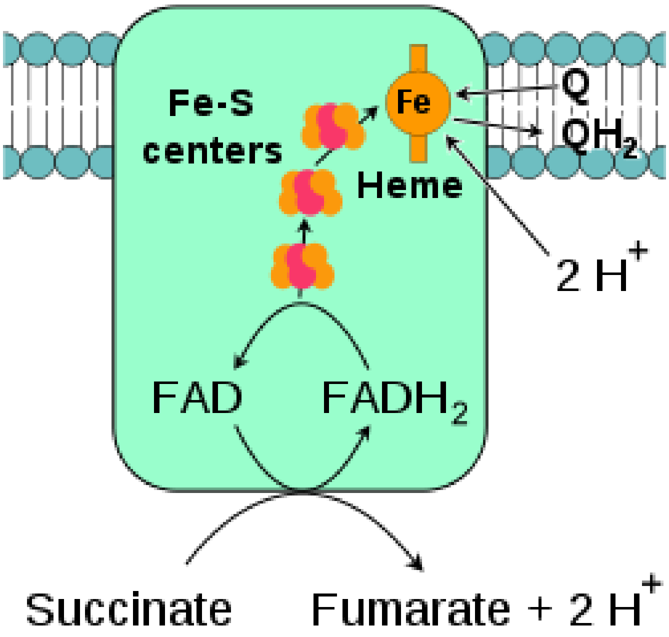
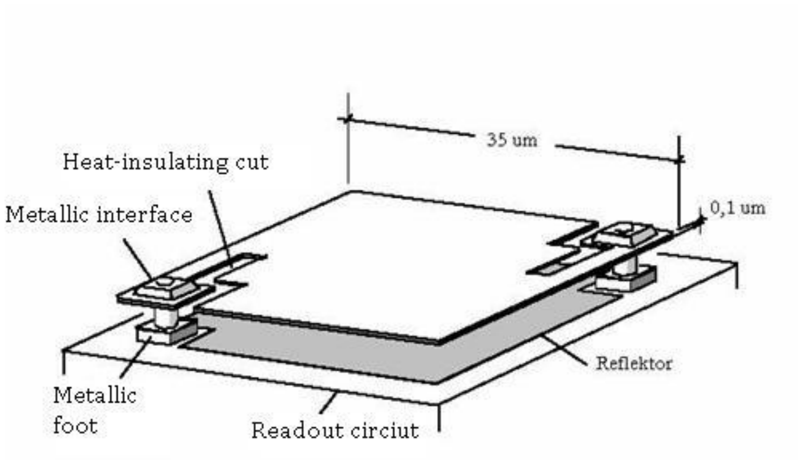
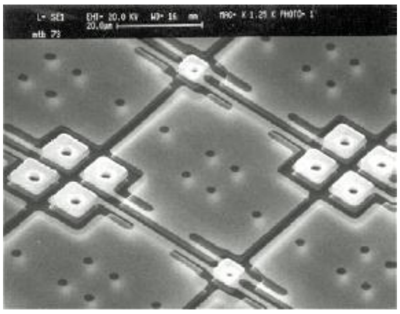


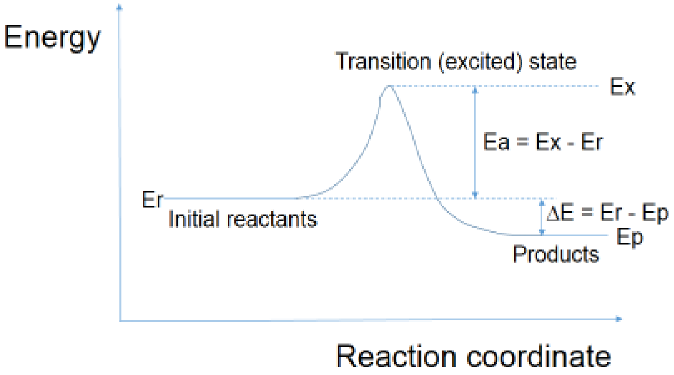
1. Somatoinfra light detection technology

The detection of somatoinfra light is based on bolometer technology, shown below.



Schematic structure of the bolometer that is used to detect infrared radiation.





Reaction coordinate diagram for exothermic reaction

In a chemical reaction, the reactants collide to form a **transition or excited state,** marked by the enthalpic maximum in the reaction coordinate diagram, which proceeds to the product. In an exothermic reaction, reactants form products of lesser chemical energy. The difference in energy between reactants and products, represented as ΔH_{rxn}, is turned into heat, physically realized as excitations in the vibrational state of the normal modes of the product. Since vibrational energy is generally much greater than the thermal agitation, it rapidly disperses in the solvent (water in the human tissues) through molecular rotation. This is how exothermic reactions make their solutions hotter.

Chemiluminescence (sometimes "**chemoluminescence**") is the emission of light (luminescence), as the result of a chemical reaction. There may also be limited emission of heat. Given reactants **A** and **B**, with an excited intermediate ◊,

[**A**] + [**B**] → [◊] → [*Products*] + light

For example, if [A] is luminol and [B] is hydrogen peroxide in the presence of a suitable catalyst we have:

luminol + hydrogen peroxide → 3-APA[◊] → 3-APA + light

where:

- where 3-APA is 3-aminophthalate
- 3-APA[◊] is the vibronic excited state fluorescing as it decays to a lower energy level.

The decay of this excited state[◊] to a lower energy level causes light emission. In theory, one photon of light should be given off for each molecule of reactant. This is equivalent to Avogadro's number of photons per mole of reactant. In actual practice, non-enzymatic reactions seldom exceed 1% Q_C, quantum efficiency.

In a chemical reaction, reactants collide to form a transition state, the enthalpic maximum in a reaction coordinate diagram, which proceeds to the product. Normally, reactants form products of lesser chemical energy. The difference in energy between reactants and products, represented as ΔH_{rxn}, is turned into heat, physically realized as excitations in the vibrational state of the normal modes of the product. Since vibrational energy is generally much greater than the thermal agitation, it rapidly disperses in the solvent through molecular rotation.

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End of the I’st Part.