

Towards Application of Conducting Polymers in DNA Sensors

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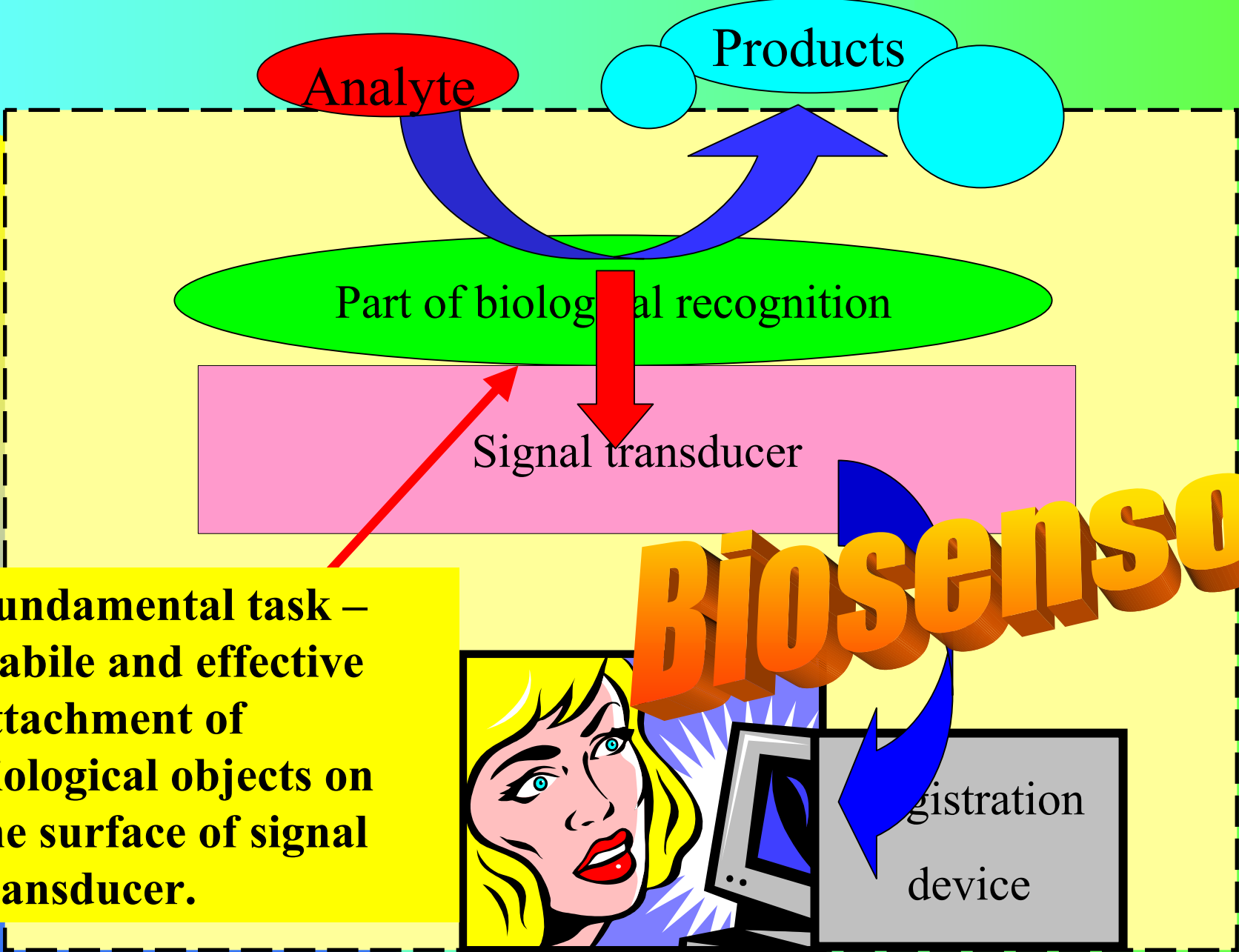
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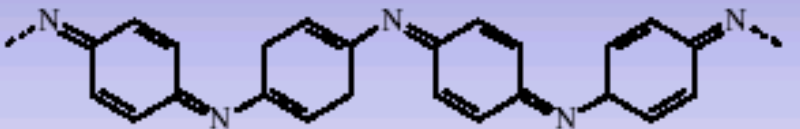
Fundamental task – stable and effective attachment of biological objects on the surface of signal transducer.



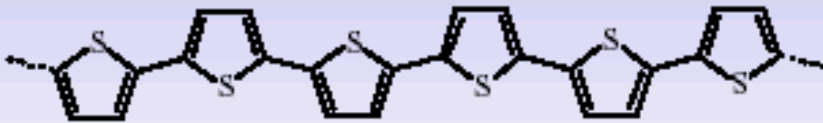
Chemical structures of some conducting polymers



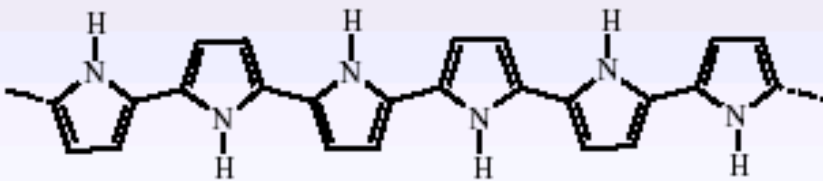
Poly(*para*-phenylene)



Poly(aniline)

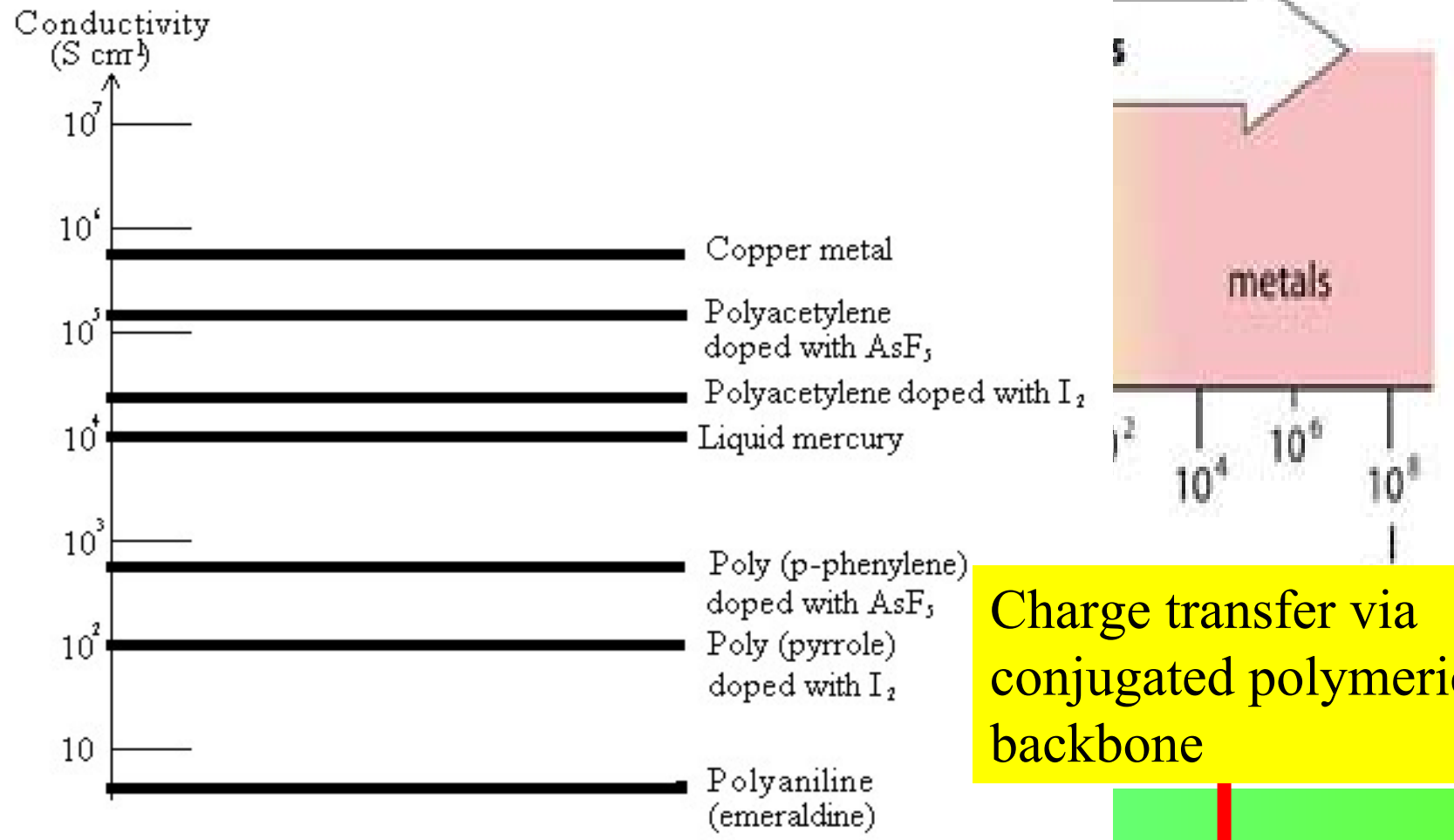


Poly(thiophene)



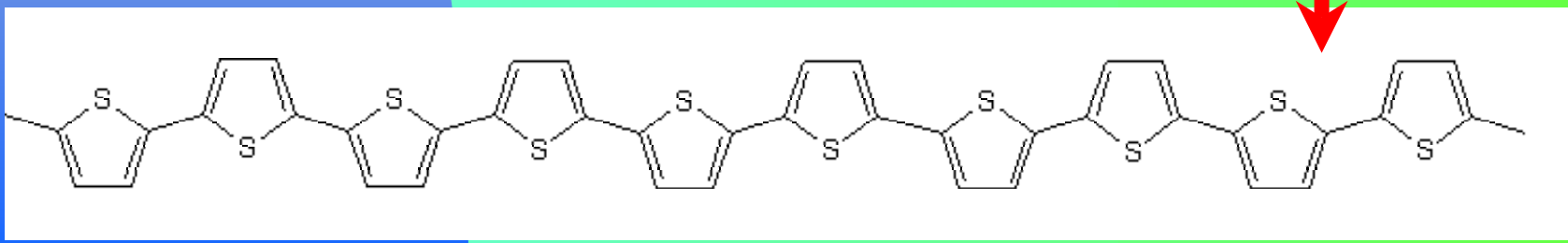
Poly(pyrrole)

Conducting (π - π conjugated) polymers can be successfully applied to solv



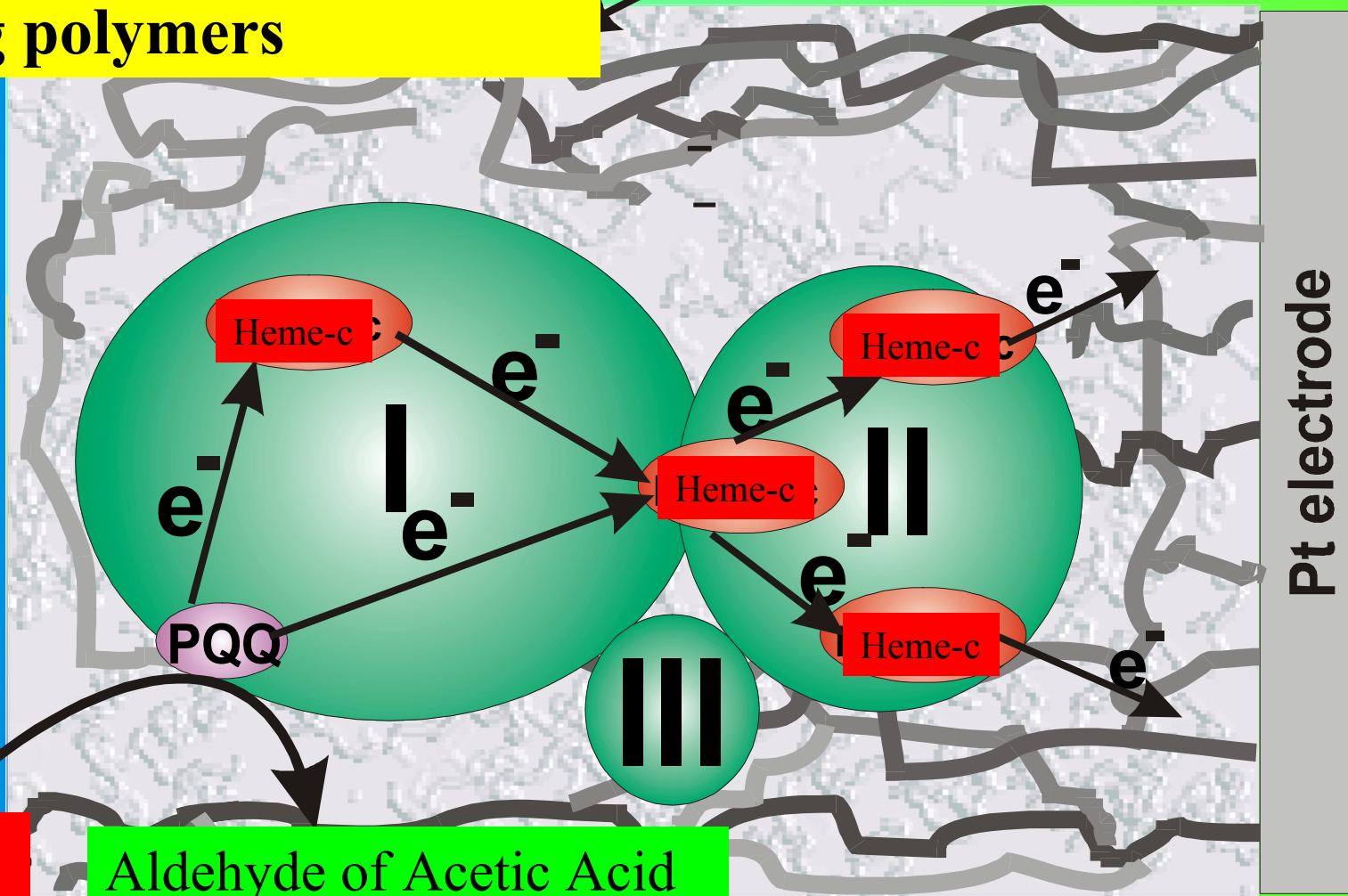
Charge transfer via conjugated polymeric backbone

Logarithmic conductivity ladder locating some metals and conducting polymers



Enzymatic biosensors based on conducting polymers

Polypyrrole



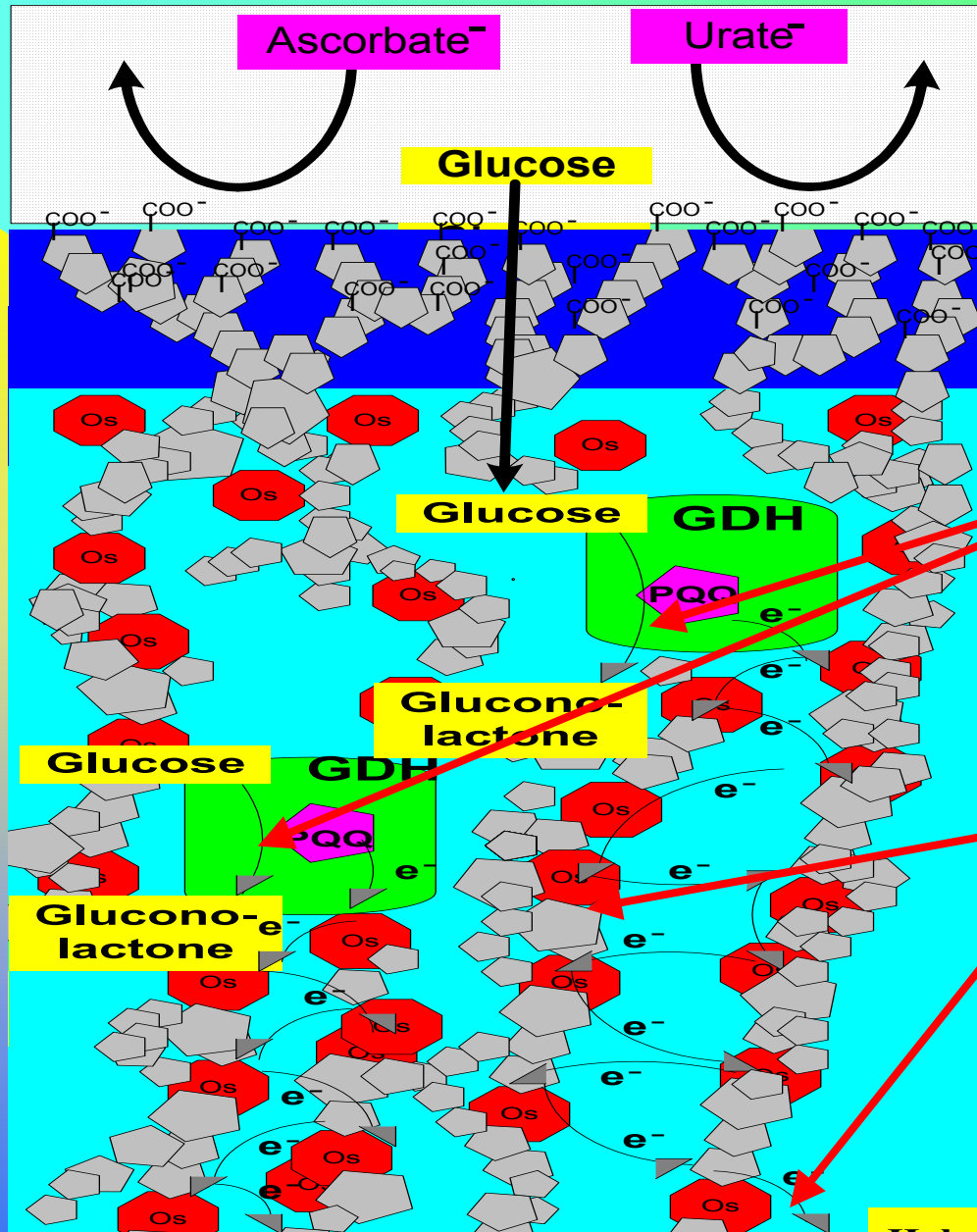
Ethanol

Aldehyde of Acetic Acid

Pt electrode

Ramanavicius, A., Habermuller, K., Csoregi, E., Laurinavicius, V., Schuhmann, W., 1999. *Anal. Chem.*, 71(16), 3581-3586.

Ramanavicius, A., Habermüller, K., Razumiene, J., Meskys, R., Marcinkeviciene, L., Bachmatova, I., Csöregi, E., Laurinavicius, V., Schuhmann, W., 2000. *Progr. Coll. Polym. Sci.*, 116, 143-148.



Application of conducting polymers covalently modified by redox species

Catalytic conversion of analyte

Transfer of electrons from enzyme to conducting surface by mean of "electron hopping"

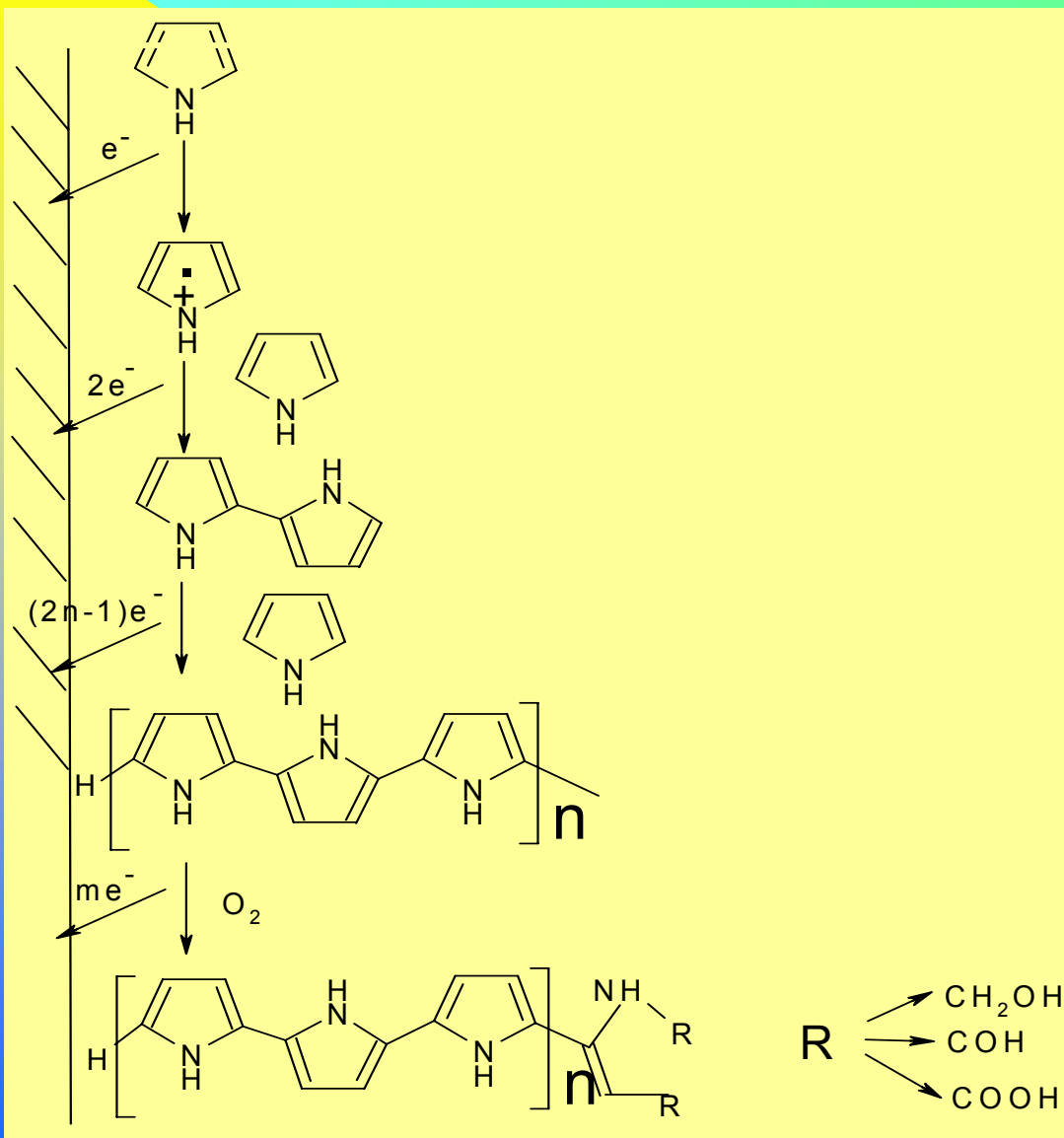
Habermüller, K., Ramanavicius, A., Laurinavicius, V., Schuhmann, W., 2000. *Electroanalysis*, 12, 1383-1389.

Pt

Methods mostly used for fabrication of polypyrrole films

- **Chemical polymerization**
- **Solvent casting**
- **Electropolymerization**

Electrochemical synthesis of polypyrrole

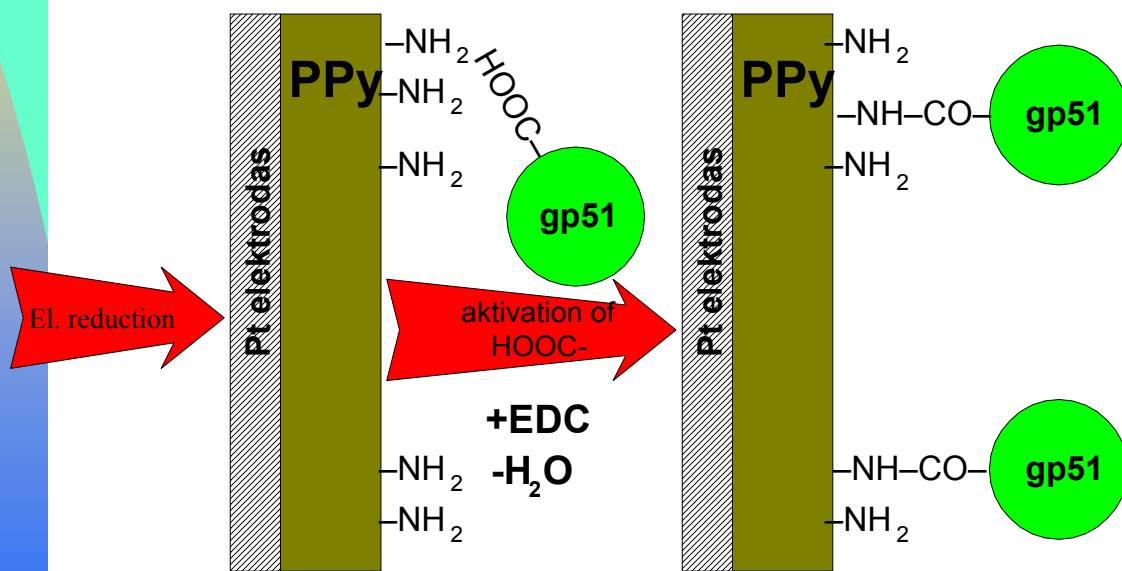
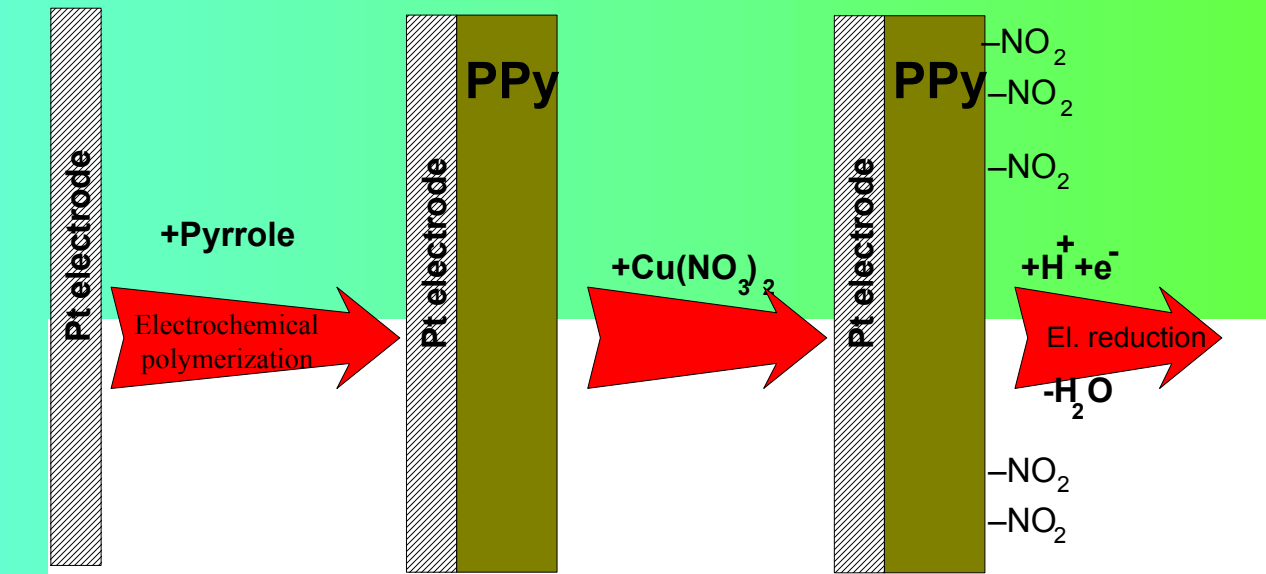


Immobilization methods based on application of Immobilization conducting polymers

■ Adsorption

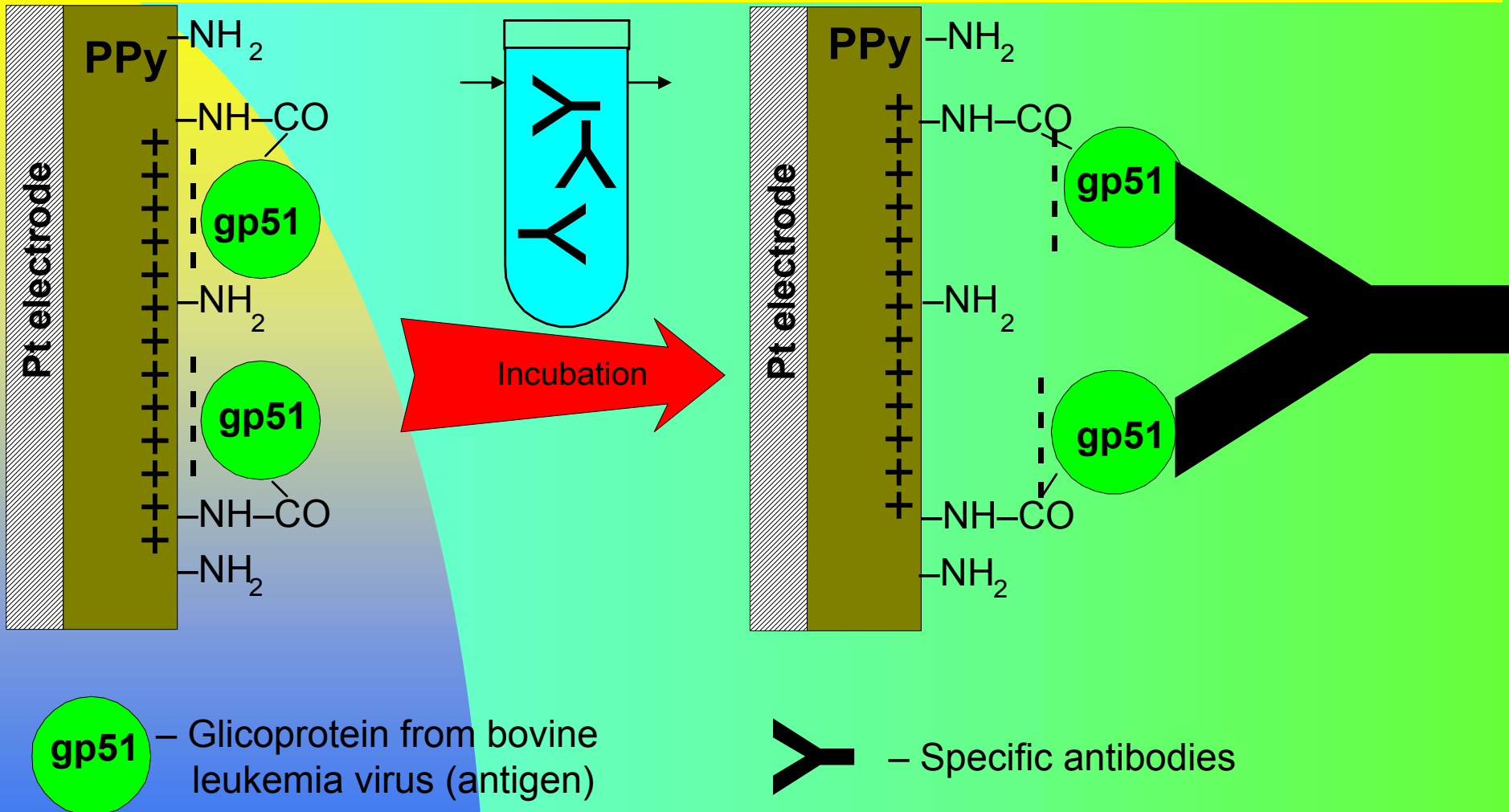
- Covalent attachment
- Entrapment
- Molecular imprinting

Covalent attachment



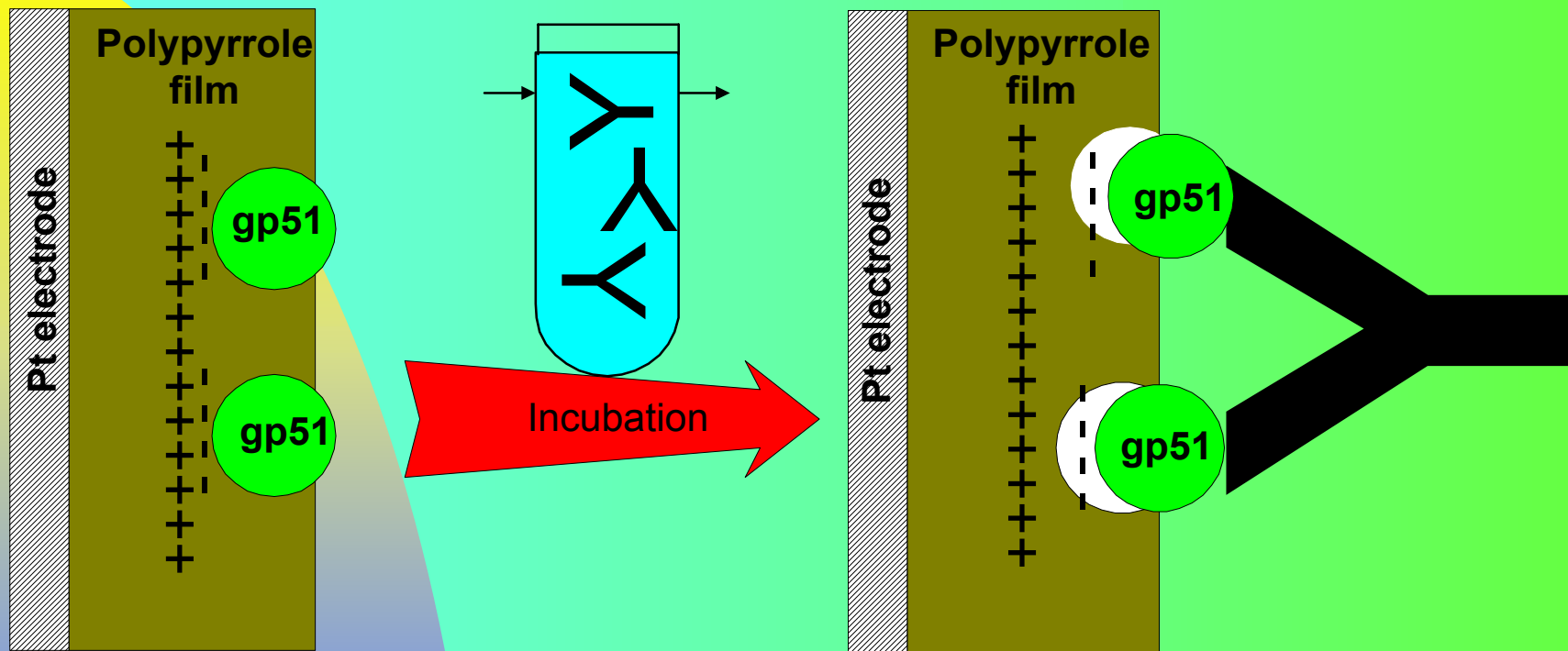
gp51 — Glicoprotein from bovine leukemia virus (antigen)

Application of covalently attached proteins in design of immunosensors



Ramanaviciene, A., Stalnionis, G., Ramanavicius A., (2004) Piezoelectric affinity biosensor for diagnosing bovine leukemia. *Biologija* 1, 33-35.

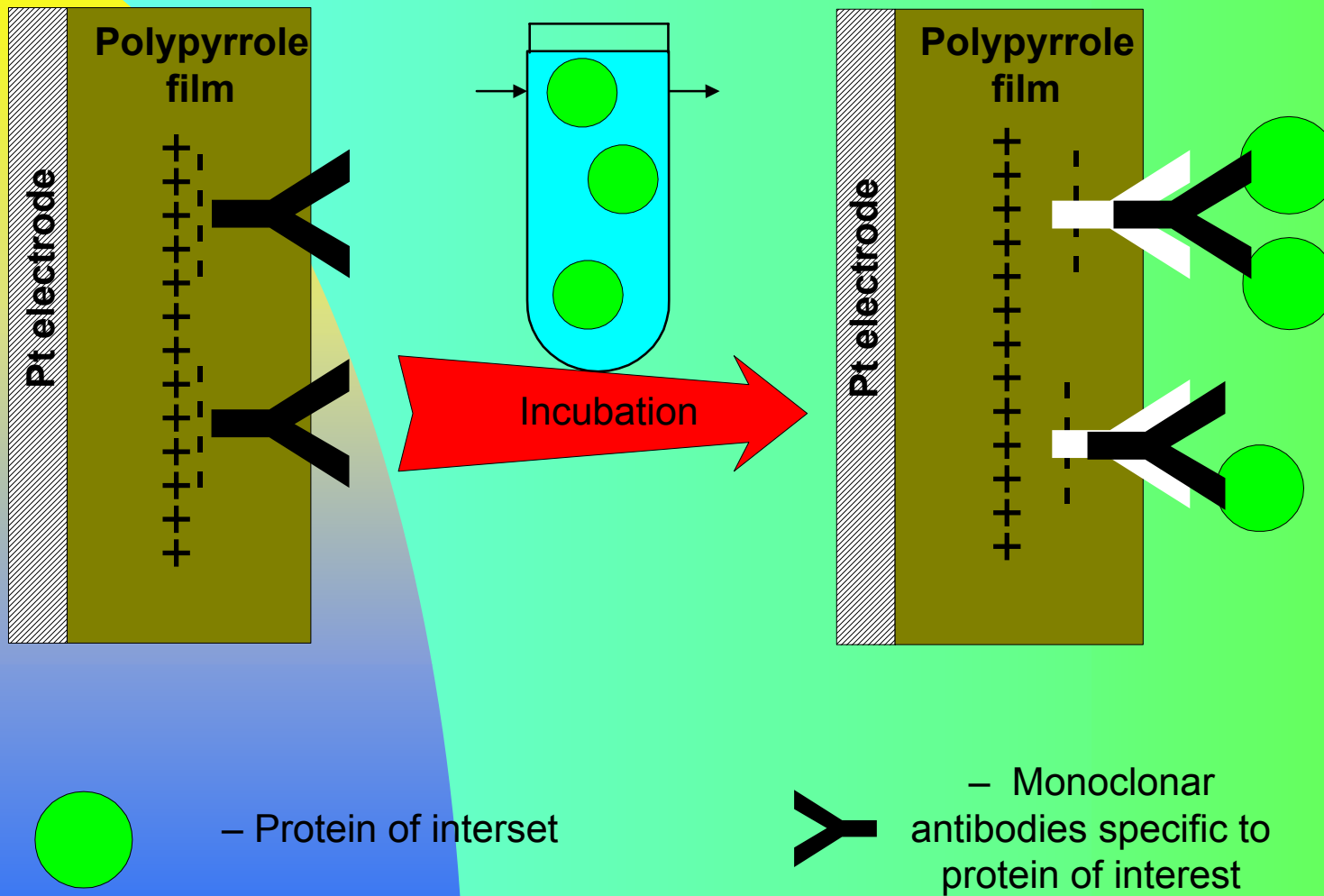
Application of conducting polymers doped by proteins in design of immunosensors



gp51 – Glicoprotein from bovine leukemia virus (antigen)

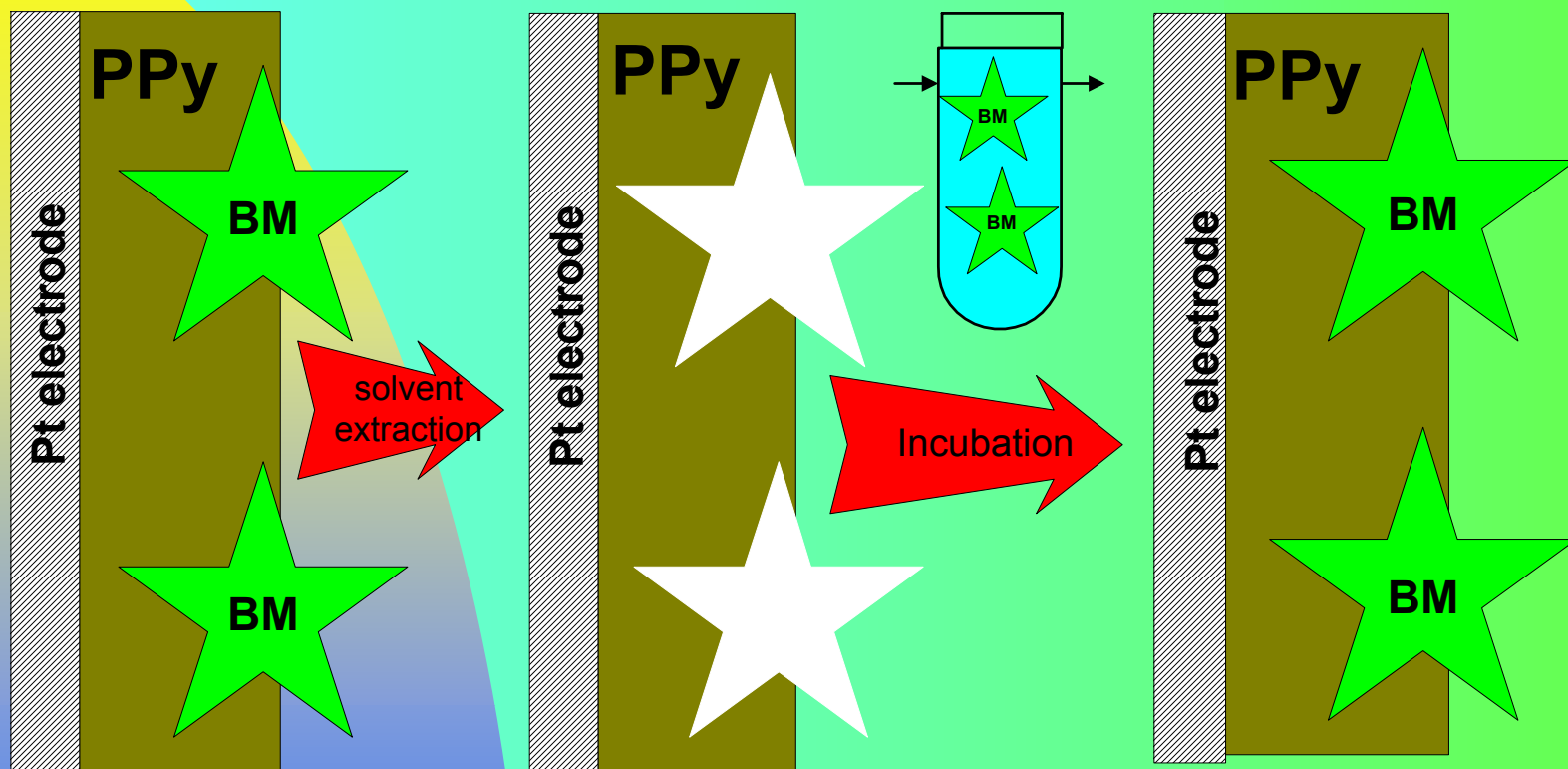
Y – Specific antibodies

Electrochemical Immunosensors for Detection of Antigens (proteins etc.)



Ramanaviciene, A., Ramanavicius, A., (2002) Application of polypyrrole for the creation of immunosensors. *Crit. reviews in Anal. Chem.* 32, 245-252.

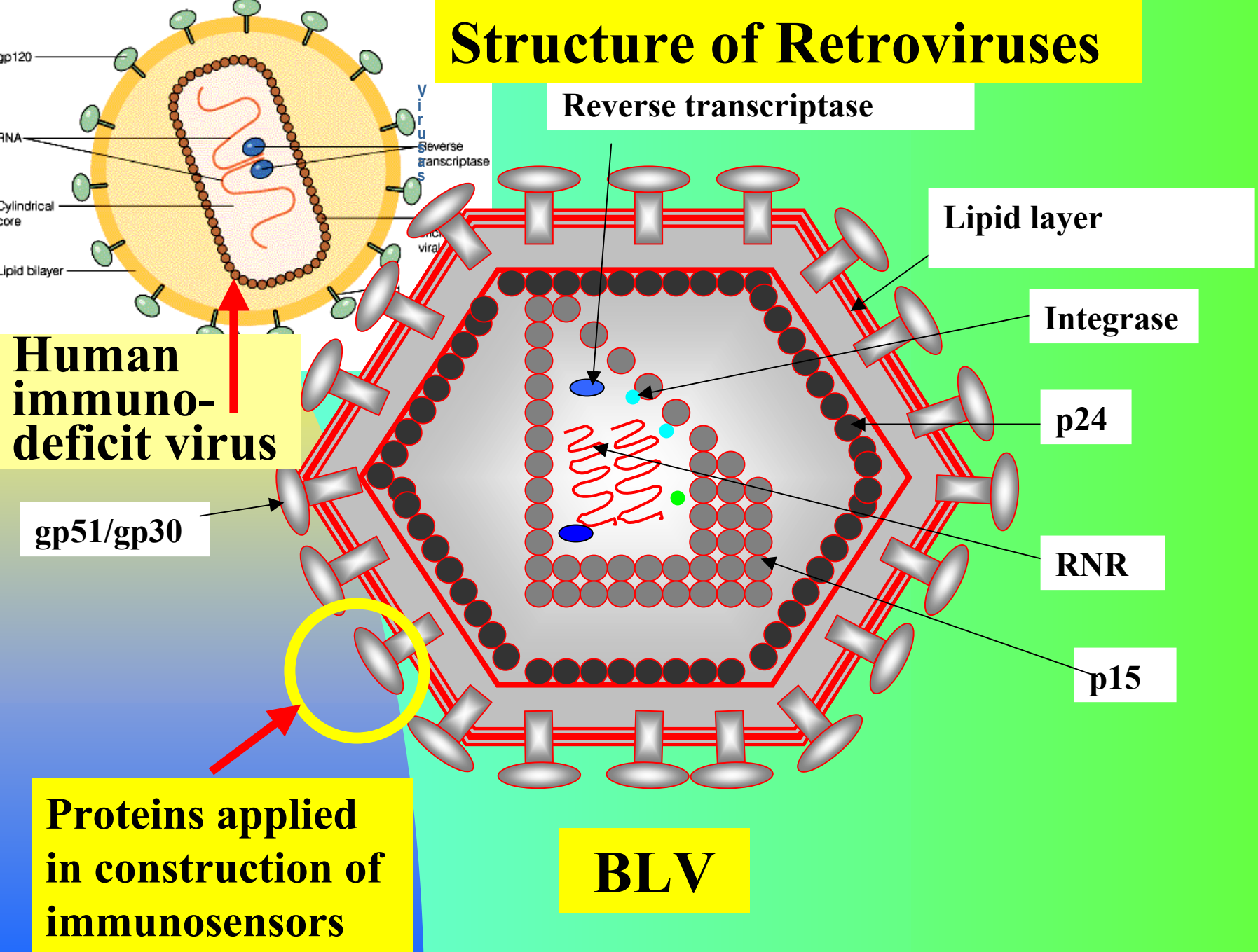
Electrochemical Affinity Sensors Based on Molecularly Imprinted Polypyrrole



Ramanaviciene A., Ramanavicius A. (2004) Molecularly imprinted polypyrrole based synthetic receptor for directly biologically active compound (analyte of interest)

Ramanaviciene A, Finkelsteinas A, Ramanavicius A. (2004) Molecularly Imprinted Polypyrrole for Sensor Design *Materials Science (Medziagotyra)* 10, 18-23.

Structure of Retroviruses



Conclusions

From the analytical point of view Ppy has a few very attractive characteristics:

- **(i) can be electrochemically formed in a controlled fashion on conducting surfaces;**
- **(ii) can be easily modified by biological objects;**
- **(iii) is biocompatible and, hence, causes minimal and reversible disturbance to the working environment;**
- **(iv) is capable to transduce the energy arising from interaction between affinity reagents into electrical signals that are easily monitored;**
- **(v) protects electrodes from fouling and interfering materials such as electroactive anions;**

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Main activities: Development of bio-, immuno- and DNA-sensors; Development of bio-analytical methods for the food, environmental analysis and biomedical application; Synthesis and application of conducting polymers.

Other related grants:

NanoBioPolymers;

NanoBioEducation

Thank you for attention!