

Název: HIV biosensors – is electrochemistry the
right way?

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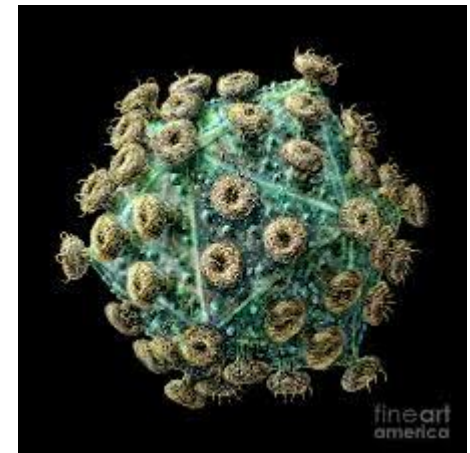
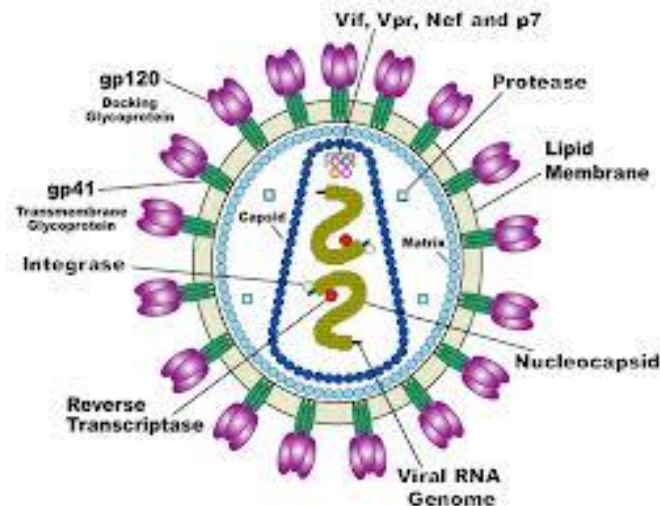
Datum: 21.2.2014

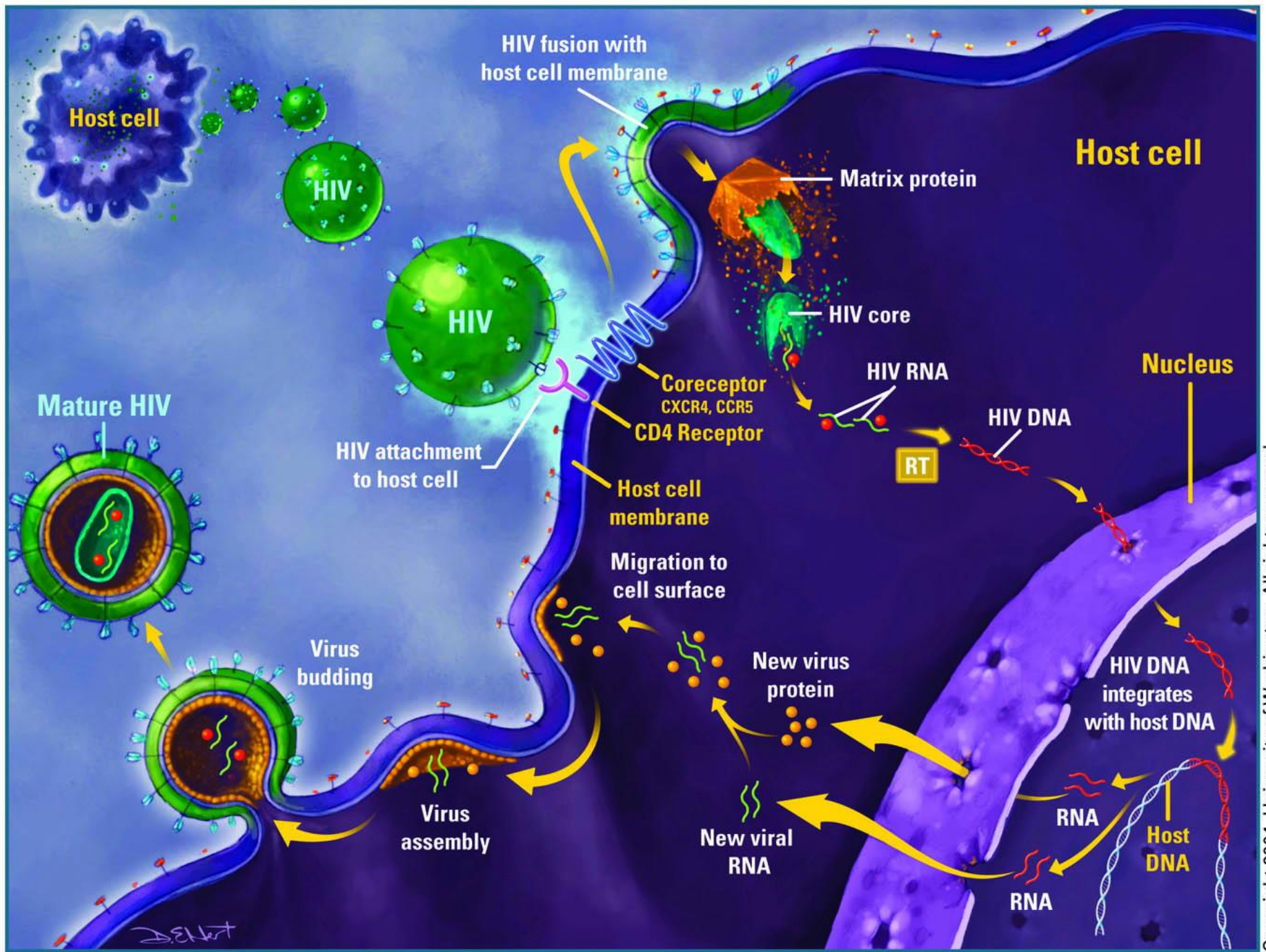
The human immunodeficiency virus - HIV

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- lentivirus that causes the acquired immunodeficiency syndrome (AIDS)
- The HIV disease was initially reported in 1981 followed by the identification of the HIV as the cause of the disease in 1983
- It is considered as global pandemic that has become the leading infectious disease
- More than 34 million individuals is currently infected with HIV

□ Structure of HIV:





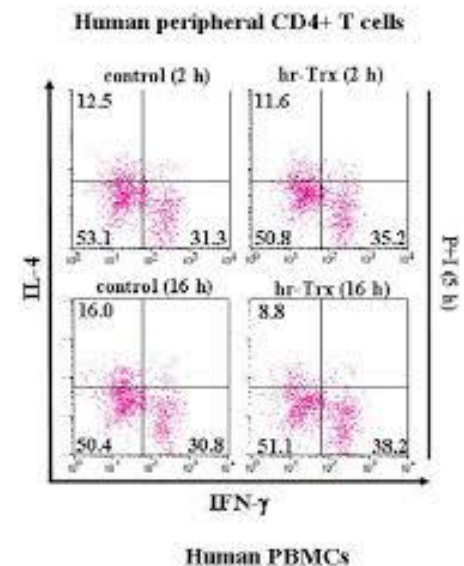
HIV – common diagnostics

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- The HIV diagnosis is a highly reliable in developed world – common methods for diagnosis are:
- **ELISA** – HIV antibodies, specificity > 99%
- **WESTERN BLOT** – HIV proteins (gp120, p17, gp41) antibodies, specificity 97.8%
- **PLASMA VIRAL LOAD** – HIV RNA isolation (plasma), sensitivity 20 – 50 molecules per mL of plasma
- **FLOW CYTOMETRY** – CD4+ T-lymphocytes

...what are the features of these methods?

Time consuming, laborous, trained operator is needed, laboratory use only, high costs.



HIV – outdoor diagnostic needs

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- ❑ **1) In less developed countries (there is no money !!!)** only small numbers of methods is usseful (e.g. ELISA kits). It is due to absence of structures of centralized helth care, hospitals and specialized centers.
- ❑ In such conditions only cheap, nonlaborous and easy to use methods or instrumets are usefull.
- ❑ **2) When catastrophes occurs (there is no time !!!)**
- ❑ Earthquakes, Tsunami, Terroristic attack – fast screening is necessary....



What is blood donator teste on?

Hepatitis B

Hepatitis C

Syphilis

AIDS



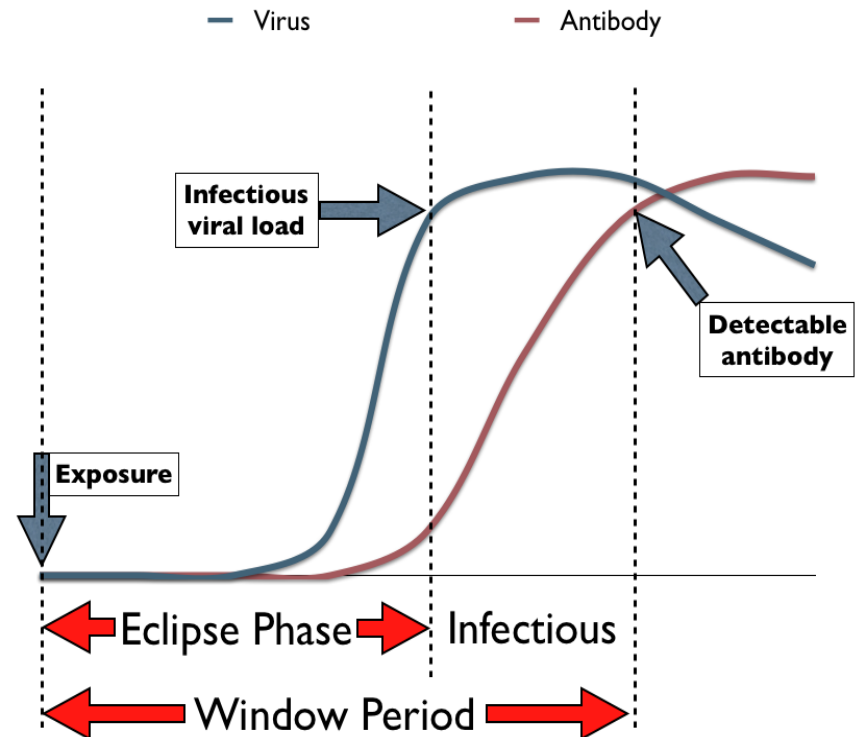
Advantage of electrochemical approaches

- Good sensitivity of electrochemical methods also facilitates the detection of HIV virions during the diagnostic window – the period when HIV antibodies are produced, but under detection limits of common diagnostic methods

- **Electrochemical bisensor based**

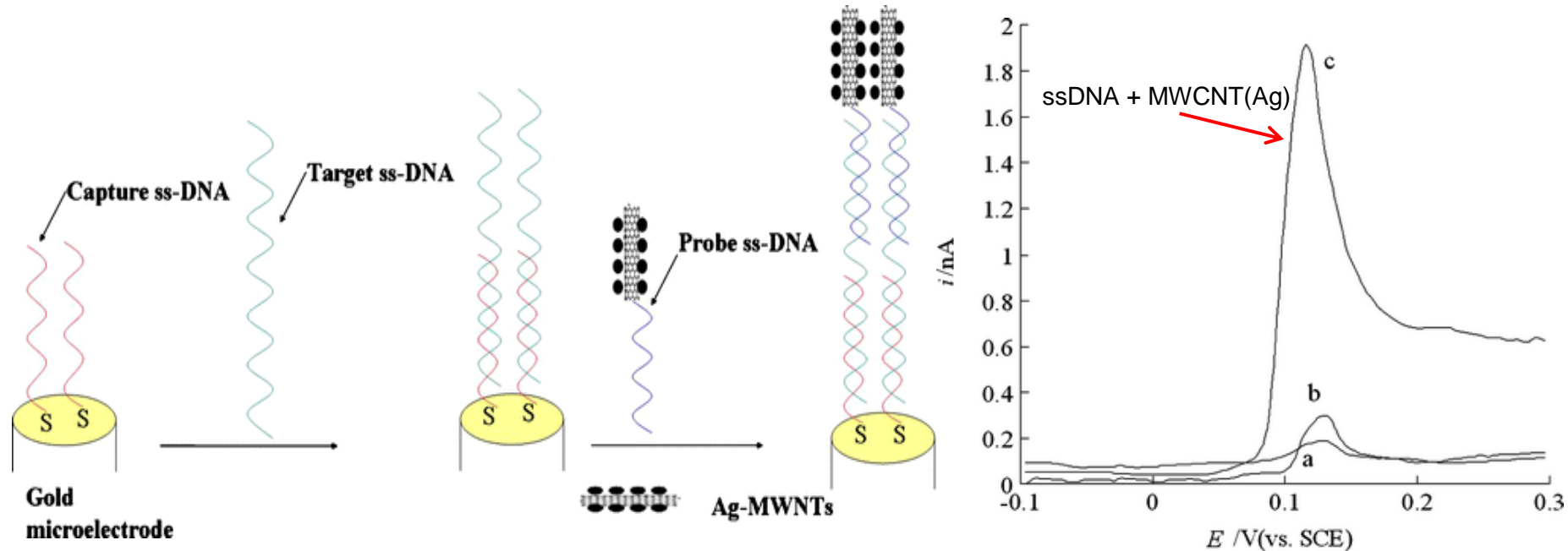
Methods provides:

- very good specificity
- relatively low costs
- good sensitivity and rapidity
- non invasivity
- possibility of miniaturization



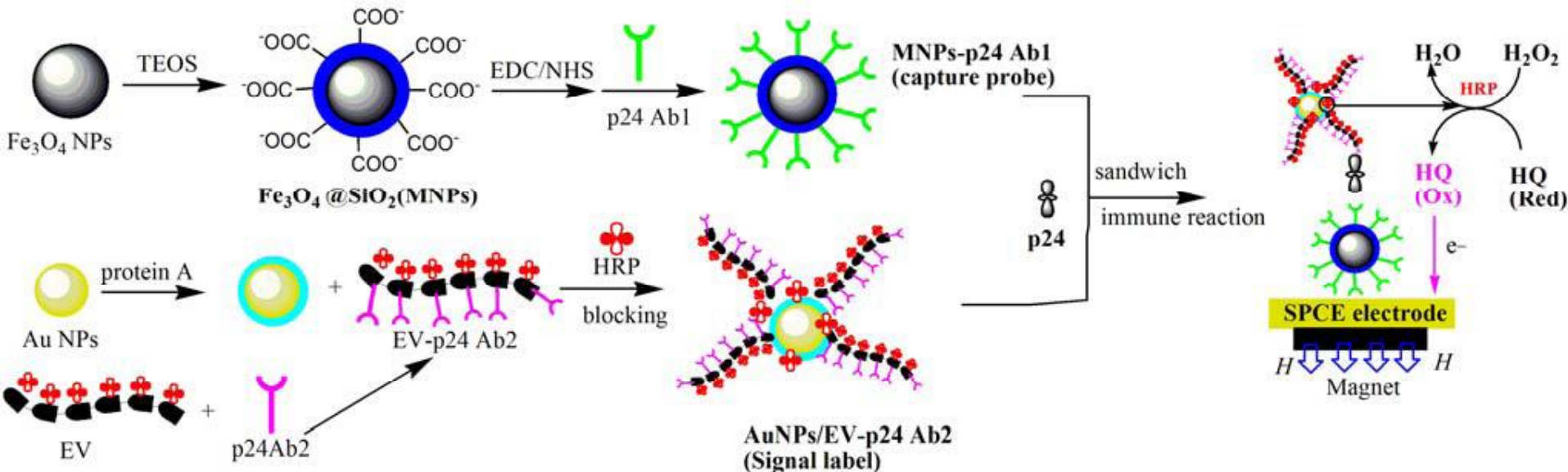
Electrochemical biosensors using sequence of HIV

- An electrochemical DNA biosensor was developed with covalent immobilization of HIV probe for single-strand DNA (ssDNA) on the modified a glassy carbon electrode (GCE). This method is the electrochemical behavior of aquabis(1,10-phenanthroline)copper(II) perchlorate $[\text{Cu}(\text{H}_2\text{O})(\text{phen})_2]\text{ClO}_4$, where phen = 1,10-phenanthroline, on binding to DNA at a GCE and in solution



Electrochemical immunosensors for HIV

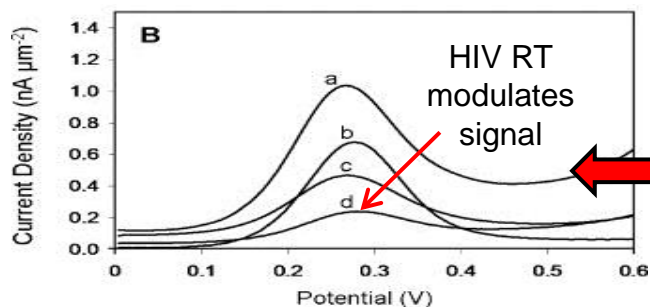
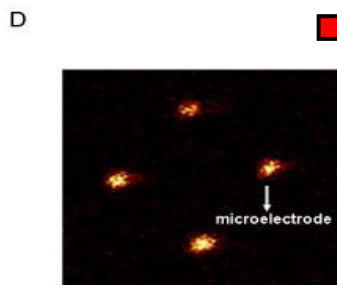
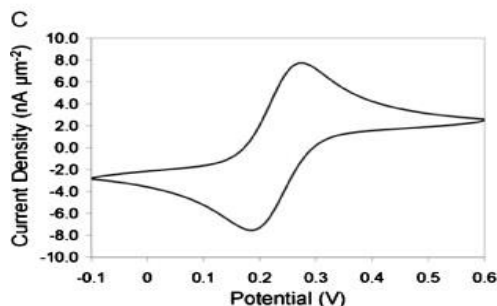
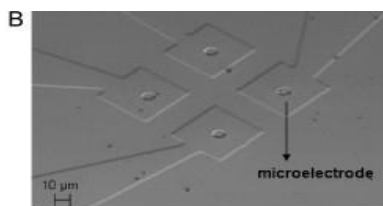
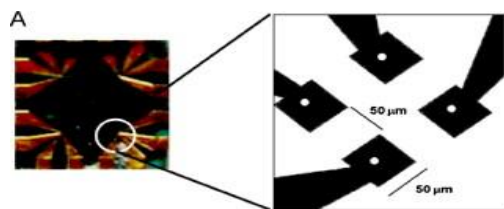
- Diagnostic tests also have focused on HIV-1-associated biomarkers as capsid p24 antigen. Ning Gan et al., showed an ultrasensitive electrochemical immunosensor for HIV p24 based on $\text{Fe}_3\text{O}_4@\text{SiO}_2$ nanomagnetic probes and nanogold colloid-labeled enzyme-antibody copolymer as signal tag



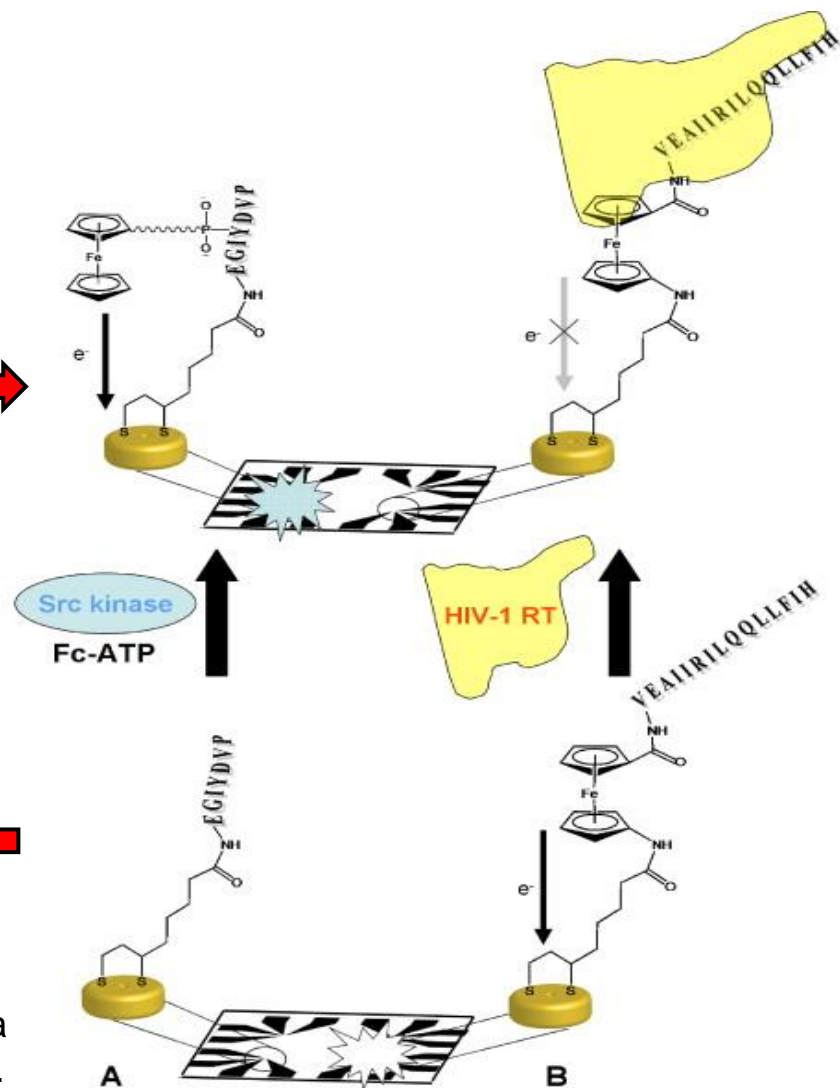
Electrochemical HIV biosensors based on RT binding on specific peptide

HIV Reverse Transcriptase chip

HIV RT LoD – 50 pg.mL⁻¹



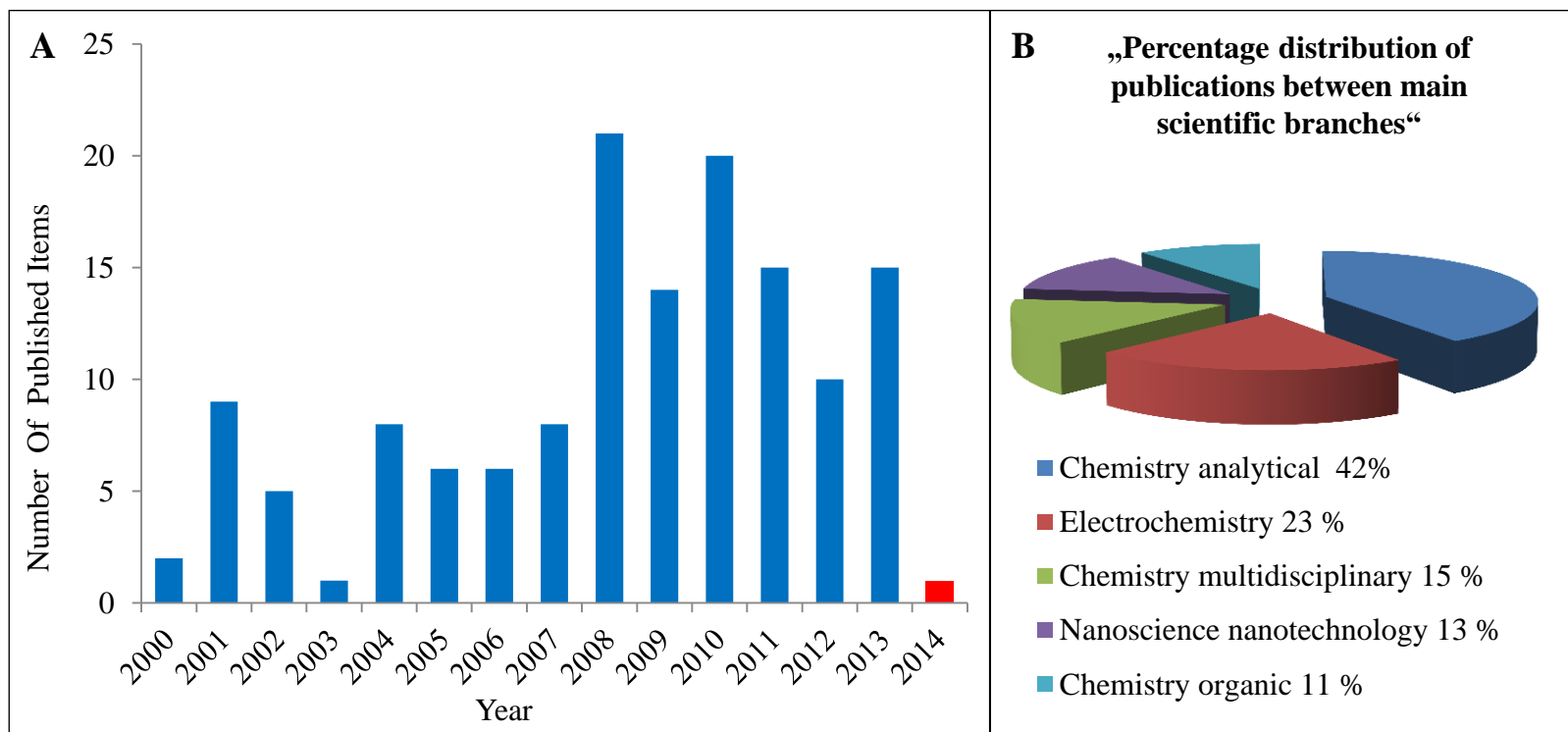
(b)



Martic *et al.*: On chip electrochemical detection of sarcoma protein kinase and HIV-1 reverse transcriptase. *Talanta*. 2011.

HIV diagnostics – is electrochemistry the right way?

- Maybe,.....yes ? Anyway the WOS shows the trend in count of publications is increasing when „HIV electrochemical“ is assigned as keyword.

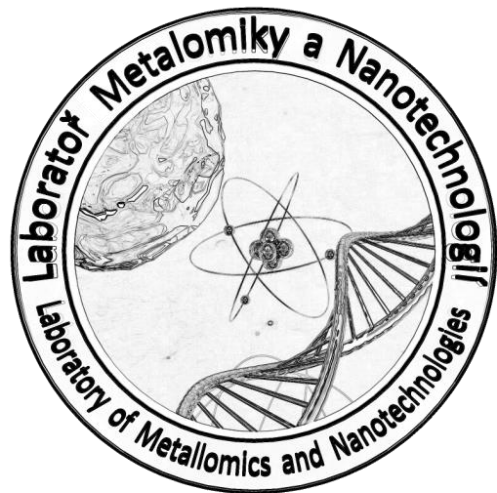


- ...unfortunately, as we can see, there is not even 1% in „molecular biology“ 😊 ☹

Acknowledgements

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INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Thank You For Your Attention

