Postdoc Fellowships for non-EU researchers

Final Report for Belspo

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Selection	
Host institution	University of Antwerp
Supervisor	Prof. Dr. Karolien De Wael and Prof. Dr. Ronny Blust
Period covered by this report	from 28/2/2015 to 30/11/2015
Title	Towards nanomaterial-modified aptasensors for the detection of environmentally important molecules

1. Objectives (max. 1/2 page)

The efficiency of an electrochemical aptasensing device is influenced by the use of different nanoparticles (NP) such as gold nanoparticles (Au), silver nanoparticles (Ag), hollow gold nanosphere (HGN), hollow silver nanosphere (HSN), silver-gold core shell (Ag@Au), gold-silver core shell (Au@Ag) and silver-gold alloy nanoparticles (Ag/Au). Among these nanomaterials, Ag@Au core shell nanoparticles are advantageous for aptasensing applications because the core improves the physical properties and the shell provides chemical stability and biocompatibility for the immobilization of aptamers. The biosensor is fabricated by self-assembly of the nanoparticles on a cysteamine film at the surface of carbon paste electrode (CPE). Then, thiolated aptamers are immobilized at these nanoframes. The nanostructured aptasensor for Escherichia coli (*E.coli*) as a target shows four times better performance in comparison to immobilized aptamer on gold electrode which suggests the use of nanomaterial can enhance the sensitivity of detection of bacterial cells. A comparison with other nanoparticles regarding the aptasensing of E.coli is done by cyclic voltammetry (CV) and differential pulse voltammetry (DPV). Also, the selectivity of the aptasensor is investigated using other kinds of bacteria. The synthetized nanoparticles and the morphology of the modified electrode are characterized by UV-Vis absorption spectroscopy, scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDX) and electrochemical impedance spectroscopy (EIS).

2. **Final results** (max. 2 pages)

Figure 1 shows images of the different synthetized nanoparticles. Figure 2 shows **(A**) differential pulse voltammograms of the Ag@Au aptasensor in (a) 0.0, (b) 10^2, (c) 5×10^2, (d) 10^3, (e) 5×10^3, (f) 10^4 and (g) 10^5 CFU/mL *E.coli* in PBS 0.1M pH 7.0; **(B)** Calibration curve for the variation of ΔI (µA) *vs.* the concentration of *E.coli* using a modified CPE with different synthetized nanoparticles; **(C)** Histogram of selectivity study for different bacteria: *E.coli*, *P.aeruginosa*, *S.aureus* and random primer (RP); **(D)** Electrochemical impedance spectra for (a) bare CPE, (b) Cys-CPE, (c) Ag@Au-Cys-CPE, (d) Apt-Ag@Au-Cys-CPE **(E)** Electrochemical impedance spectra at Apt-Ag@Au-Cys-CPE in different concentration of *E.coli* (a) 0.0, (b) 10^3, (c) 10^4, (d) 10^5 CFU/mL in the presence of 5 mM $[Fe(CN)_6]^{3-/4-}$, 0.1 M NaCl, 0.1M PBS pH 7.0, the concentration of aptamer is 2.5 µM.

Figure 1

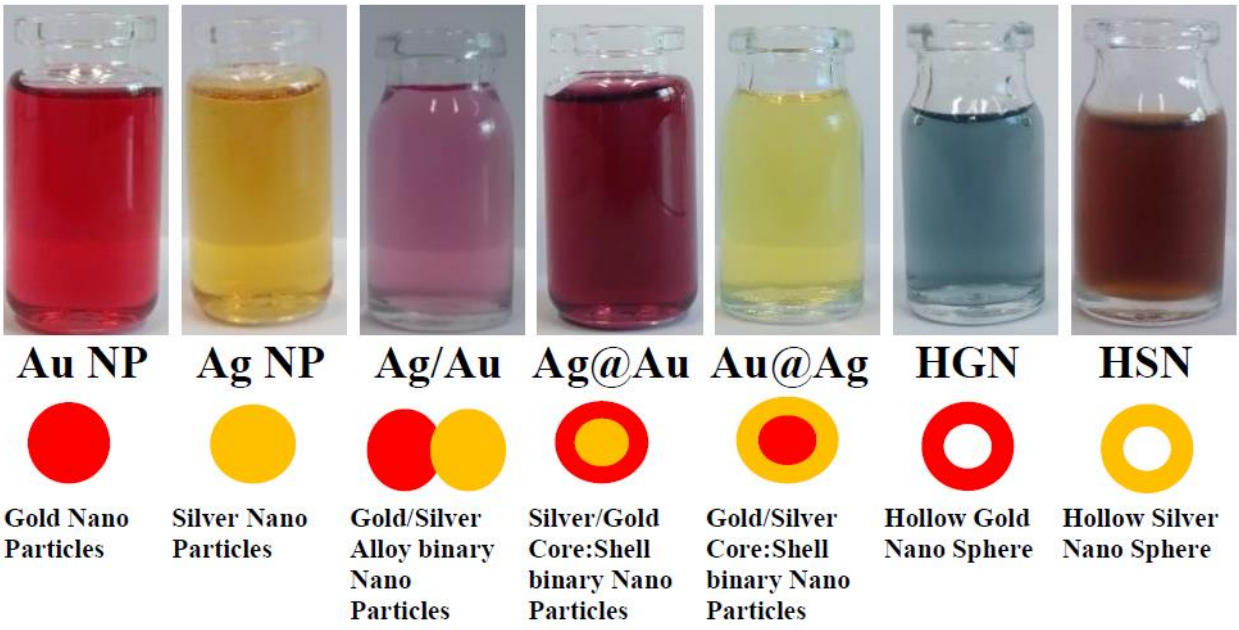
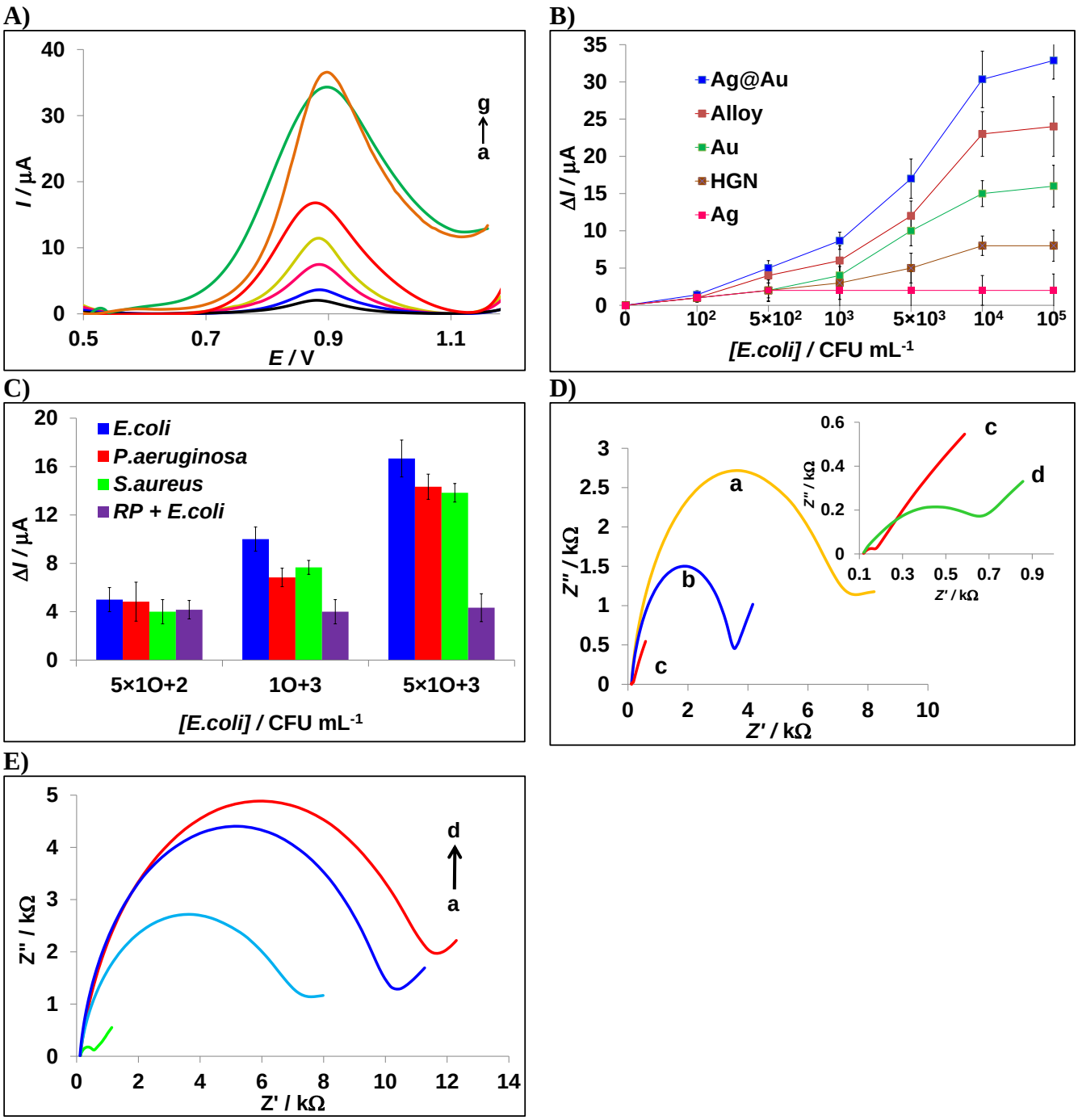


Figure 2



3. **Valorisation/Diffusion (including Publications, Conferences, Seminars, Missions abroad,** max. 1/2 page)

The results of the this project have been presented to the conference of "17th Topical Meeting of the International Society of Electrochemistry in Saint-Malo, France, 31 May - 3 June, 2015" by this

title: "Effect of Nanoparticles on the Efficiency of Aptasensors: A Comparative Study and the Aptamer of *E. coli* as a Model". Also, an article is written and submitted to the journal of Biosensors and Bioelectronics. Additionally, a review is written and will be submitted soon for publication.

4. Miscellaneous