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FUNCTIONALIZATION OF ELECTRODE SURFACES WITH THREE-DIMENSIONAL NETWORKS OF ELECTROPOLYMERIZED GOLD NANOPARTICLES FOR BIOSENSOR DESIGN

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METHODOLOGIES FOR NANOSTRUCTURING ELECTRODE SURFACES FOR BIOSENSING PURPOSES

i) TYPE OF ELECTRODE SURFACE

ii) NANOMATERIALS TO BE USED

iii) OTHER COMPOUNDS/MATERIALS

iv) PHYSICAL/CHEMICAL METHOD FOR SURFACE MODIFICATION

v) BIOMOLECULE TO BE IMMOBILIZED AND METHOD TO DO THAT

vi) ELECTROCHEMICAL REACTION TO TAKE PLACE

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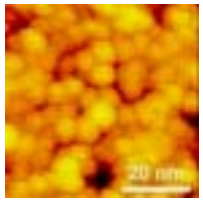
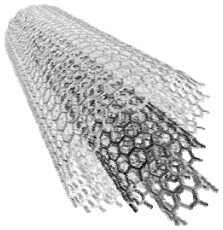
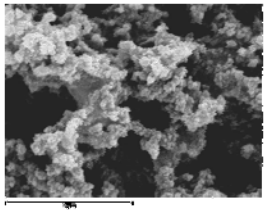


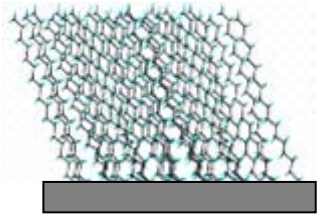
AuNPs



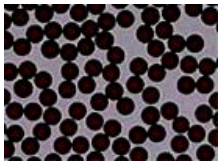
MWCNTs



CPs

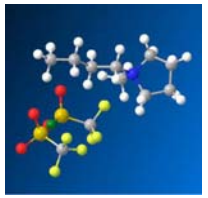


SAMs

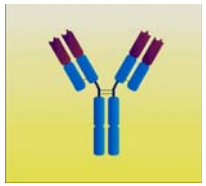


MNPs

Materials



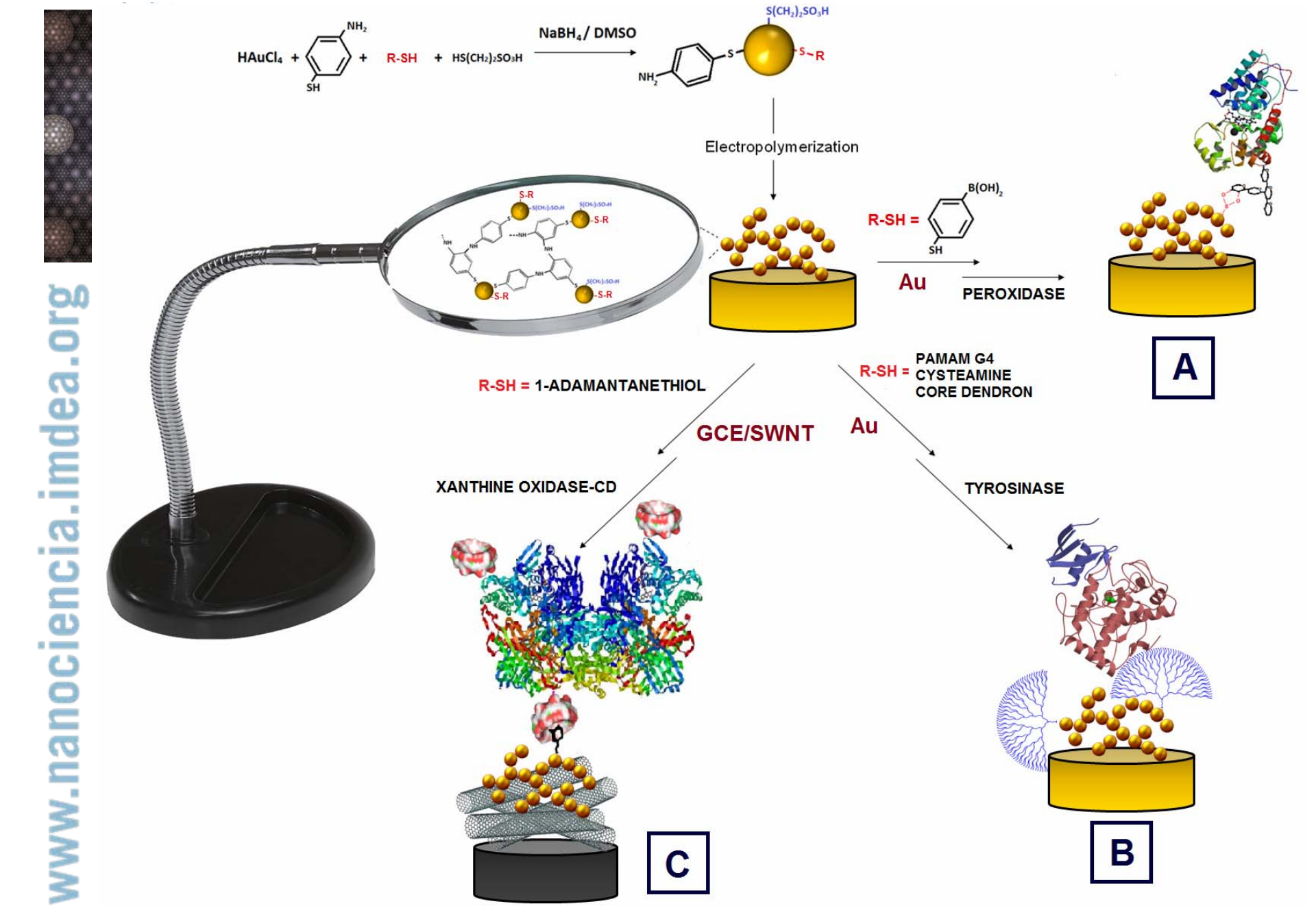
RTILs



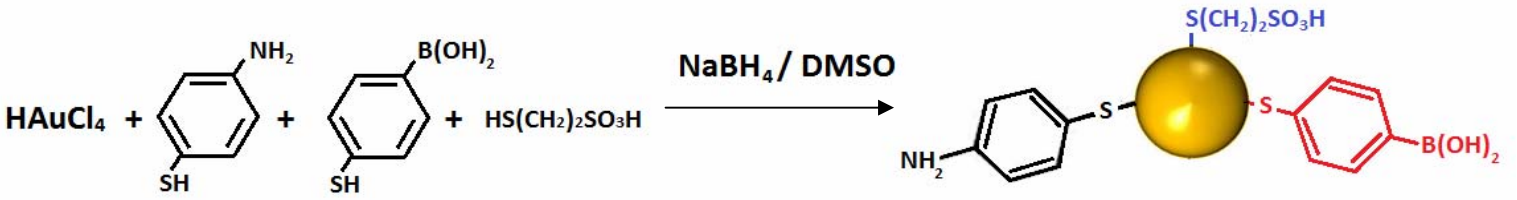
Ab

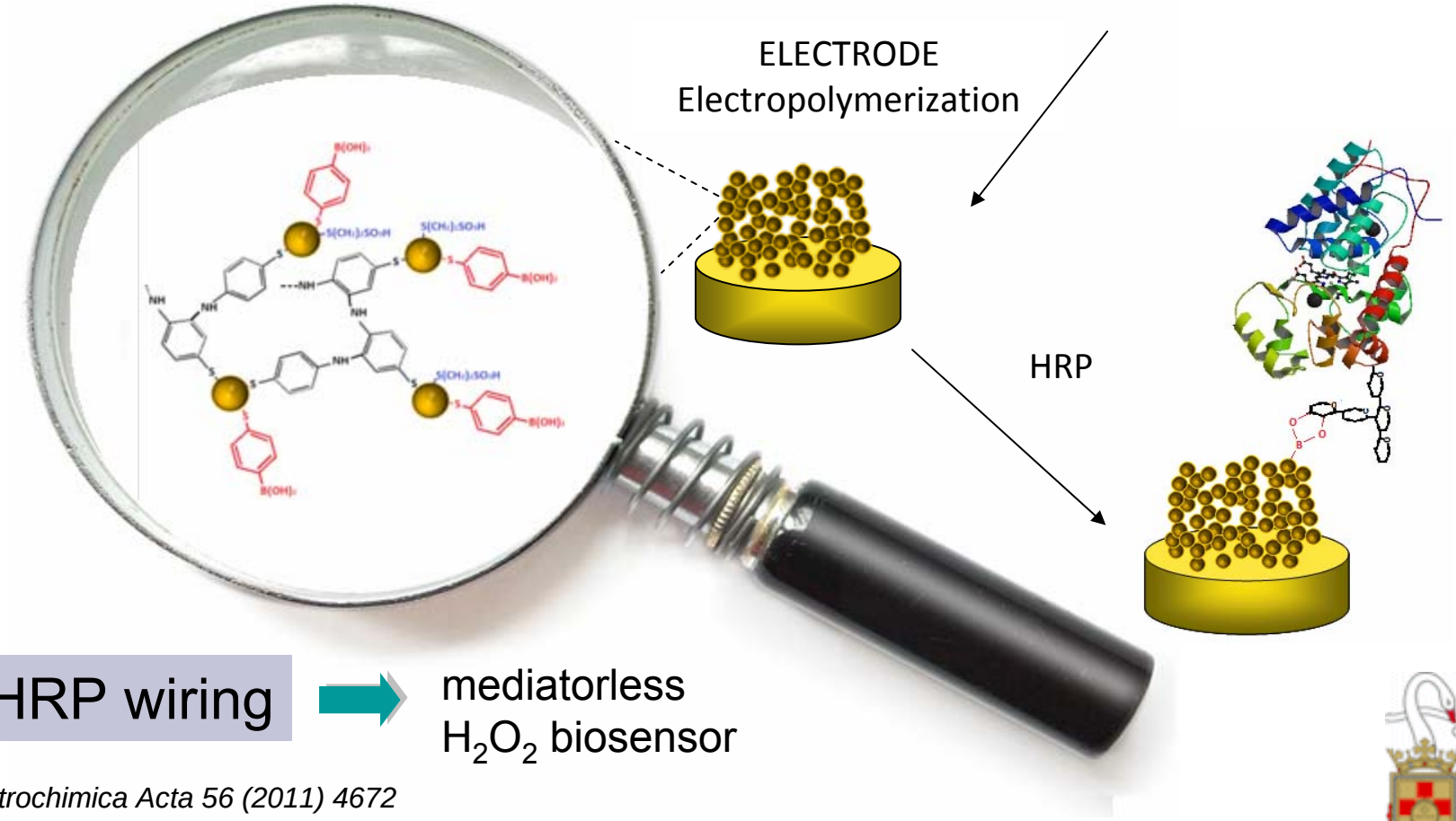
E

DNA



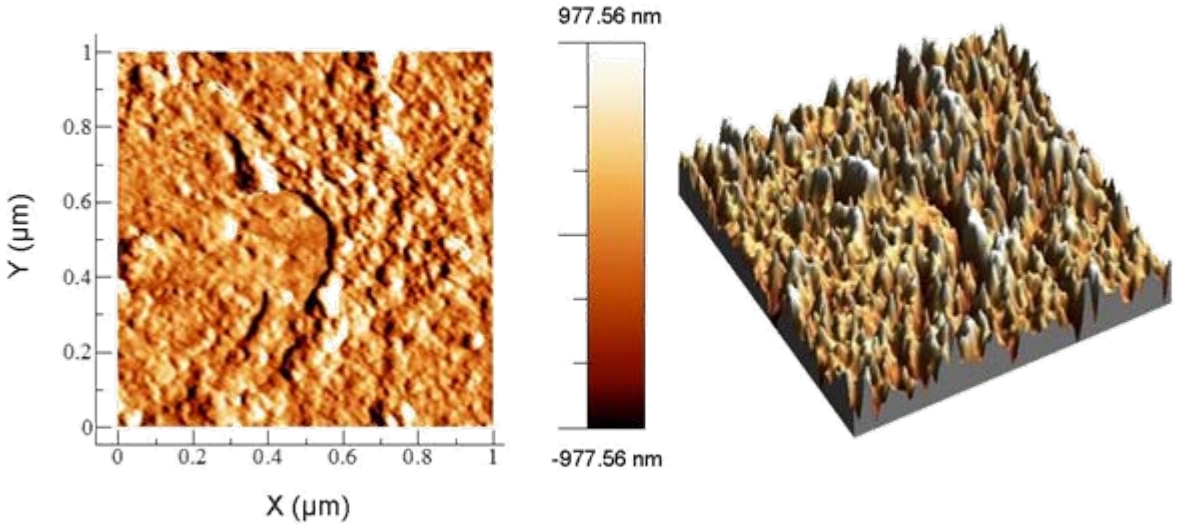
GOLD NANOPARTICLES-BASED NANOSTRUCTURED POLYMERIC NETWORK





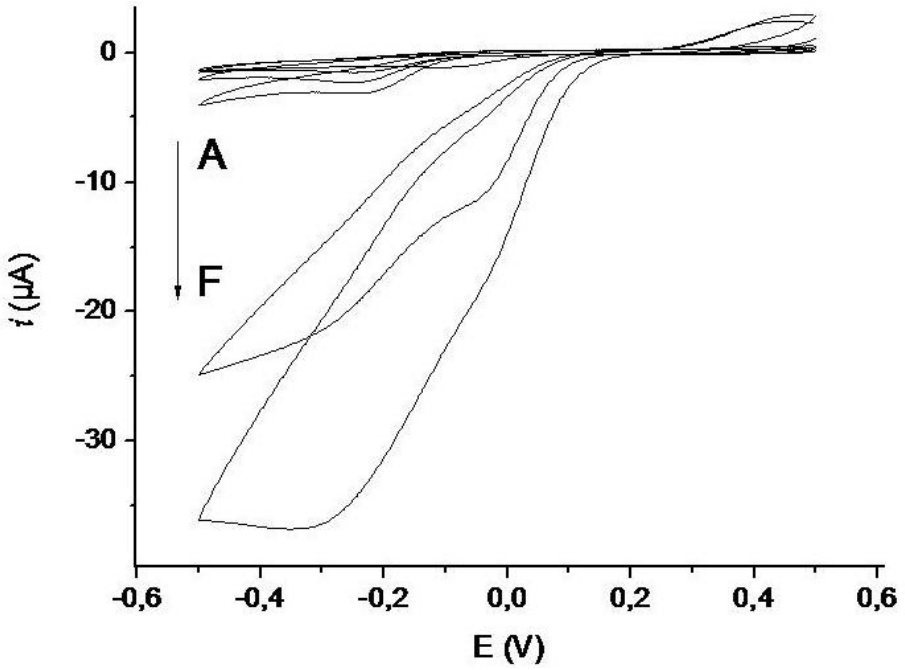
HRP wiring → mediatorless H_2O_2 biosensor

Electrochimica Acta 56 (2011) 4672

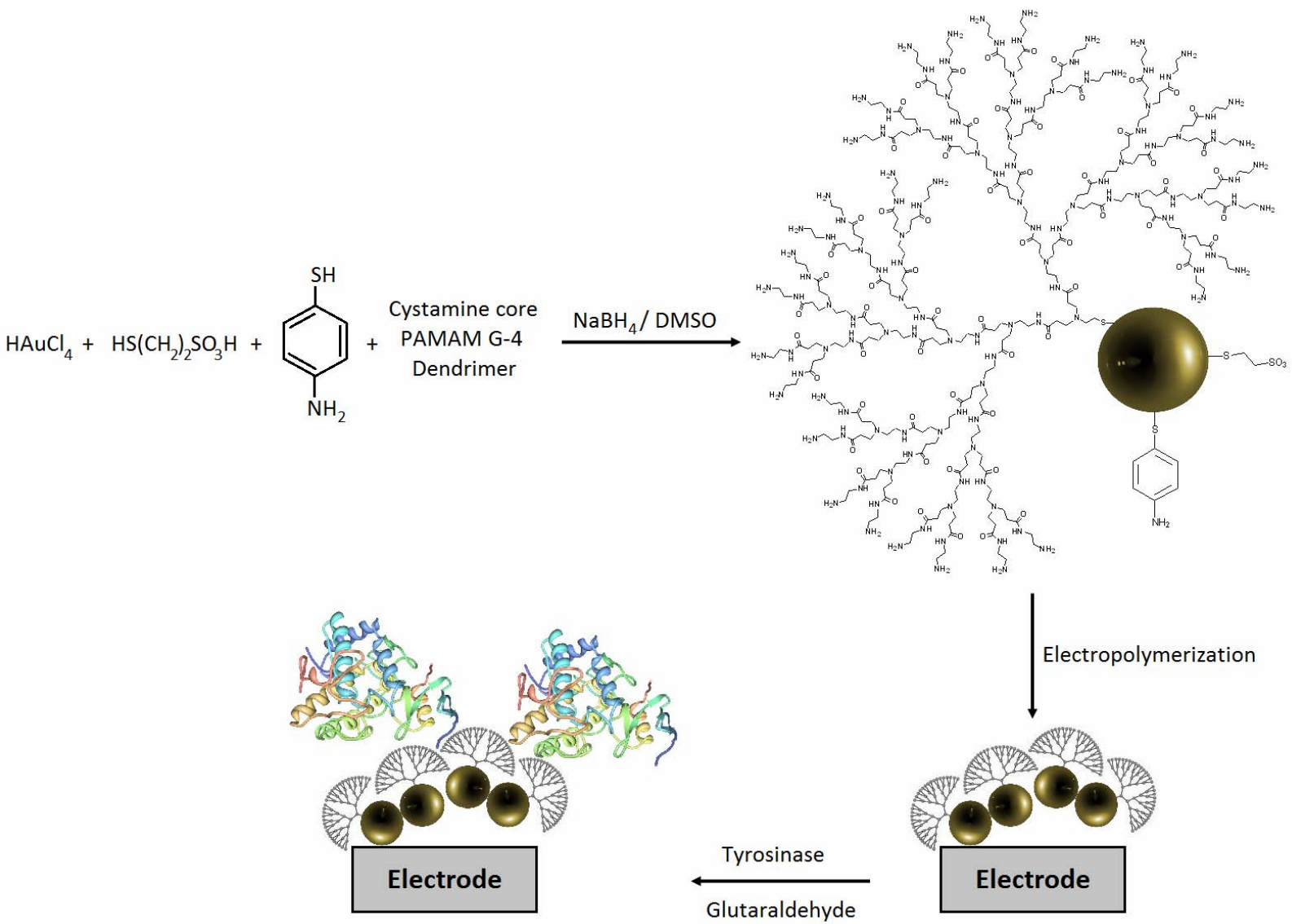


- average thickness: 984 nm
- nanoholes and AuNPs-based protuberant structures represented 47.9% and 52.1% of the total surface area, respectively.
- maximum height of AuNPs-based protuberant structures 1.96 µm

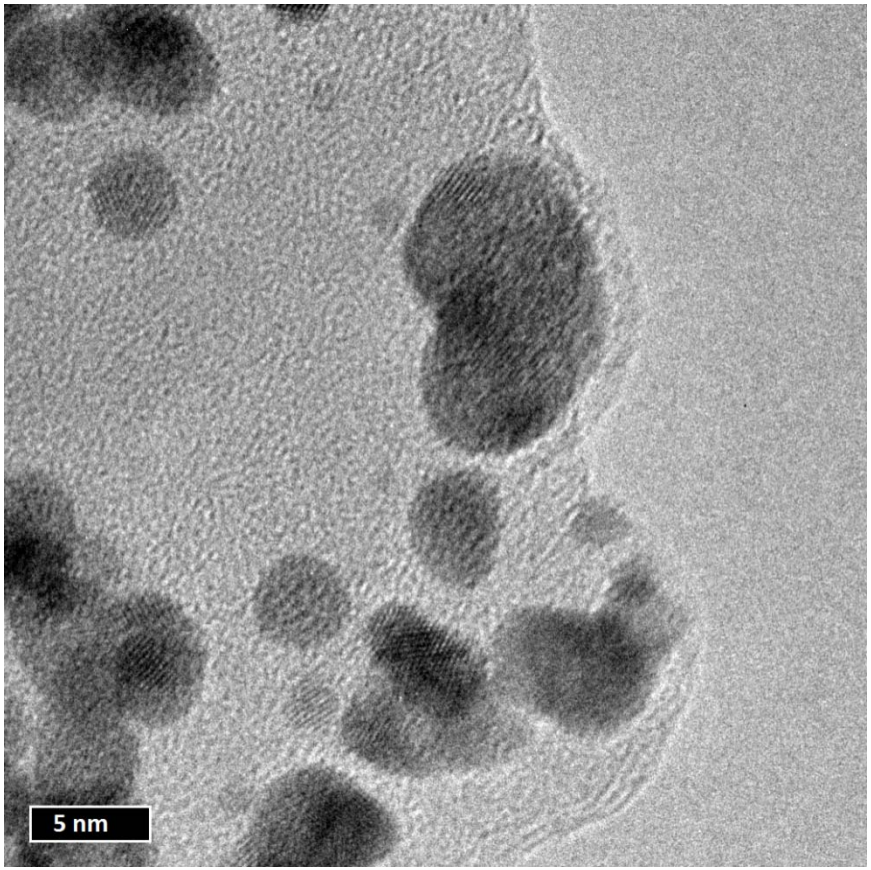
A) HRP-Au
B) HRP-polyAuNPs-Au
C) HRP-Au + 1 μM H_2O_2
D) HRP-Au + 2 μM H_2O_2
E) HRP-polyAuNPs-Au + 1 μM H_2O_2
F) HRP-polyAuNPs-Au + 2 μM H_2O_2



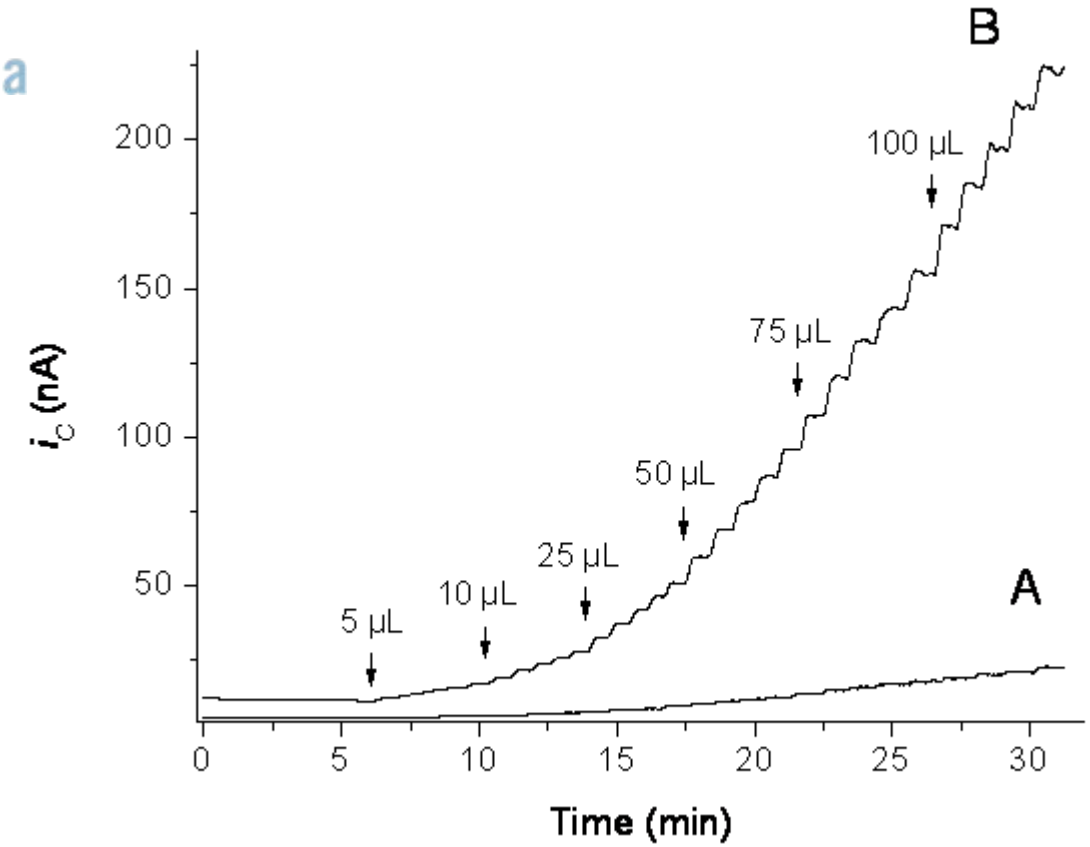
- Conclusions
- Improved electrocatalytic behaviour of HRP upon immobilization on the polyAuNPs-based conductive matrix
- Efficient electron transfer between the redox active site of the enzyme and the electrode surface



Analyst 137 (2012) 342



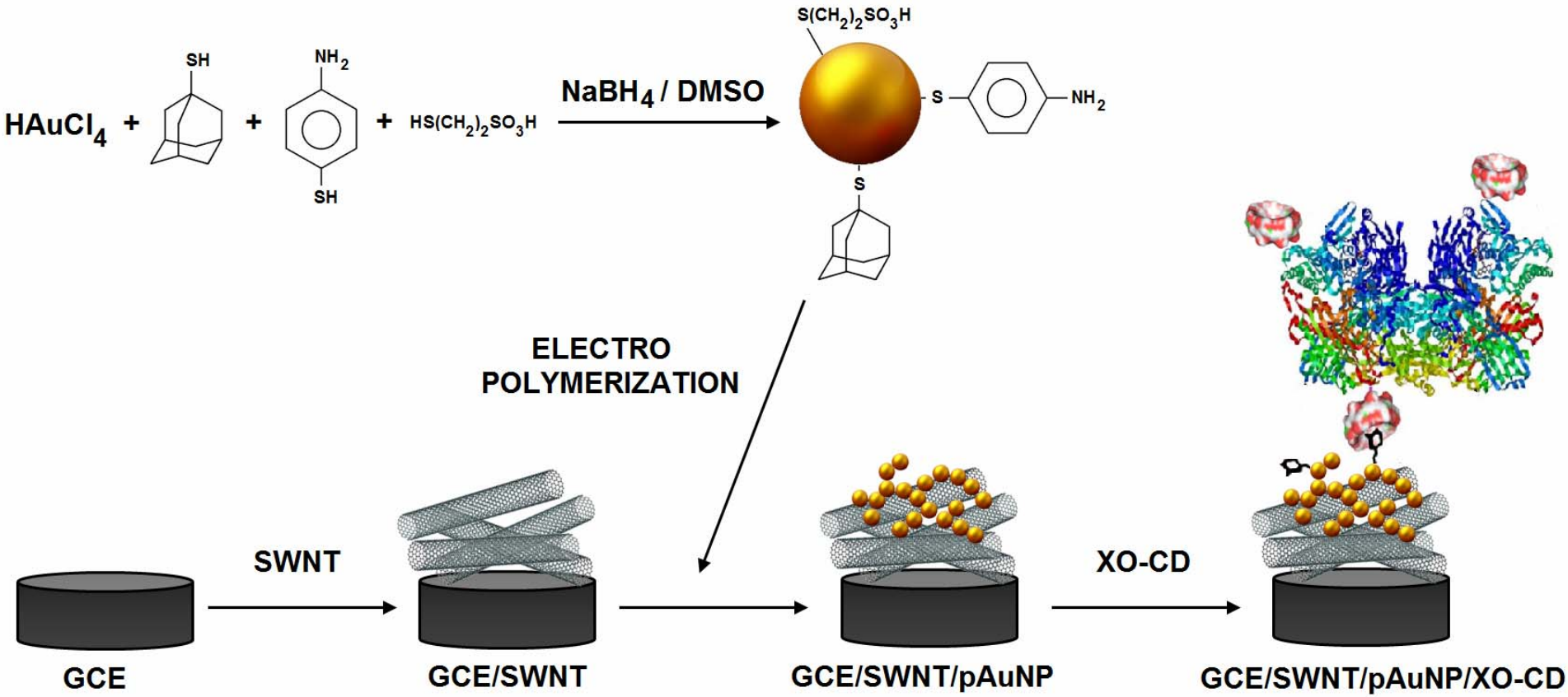
- Average diameter 5.7 ± 0.9 nm
- PAMAM G-4 dendrimers: about 4.5 nm
- Larger than that reported for metal nanoparticles encapsulated into dendritic molecules

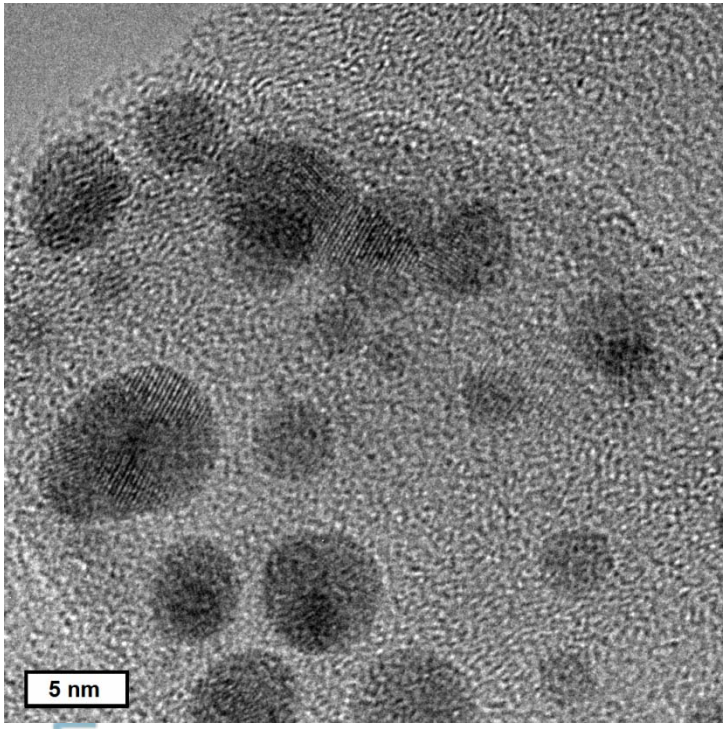


Tyr-functionalized *p*-aminothiophenol-coated non-nanostructured gold electrode **(A)** and electropolymerized PAMAM G-4 dendron-coated AuNPs-modified electrode **(B)**

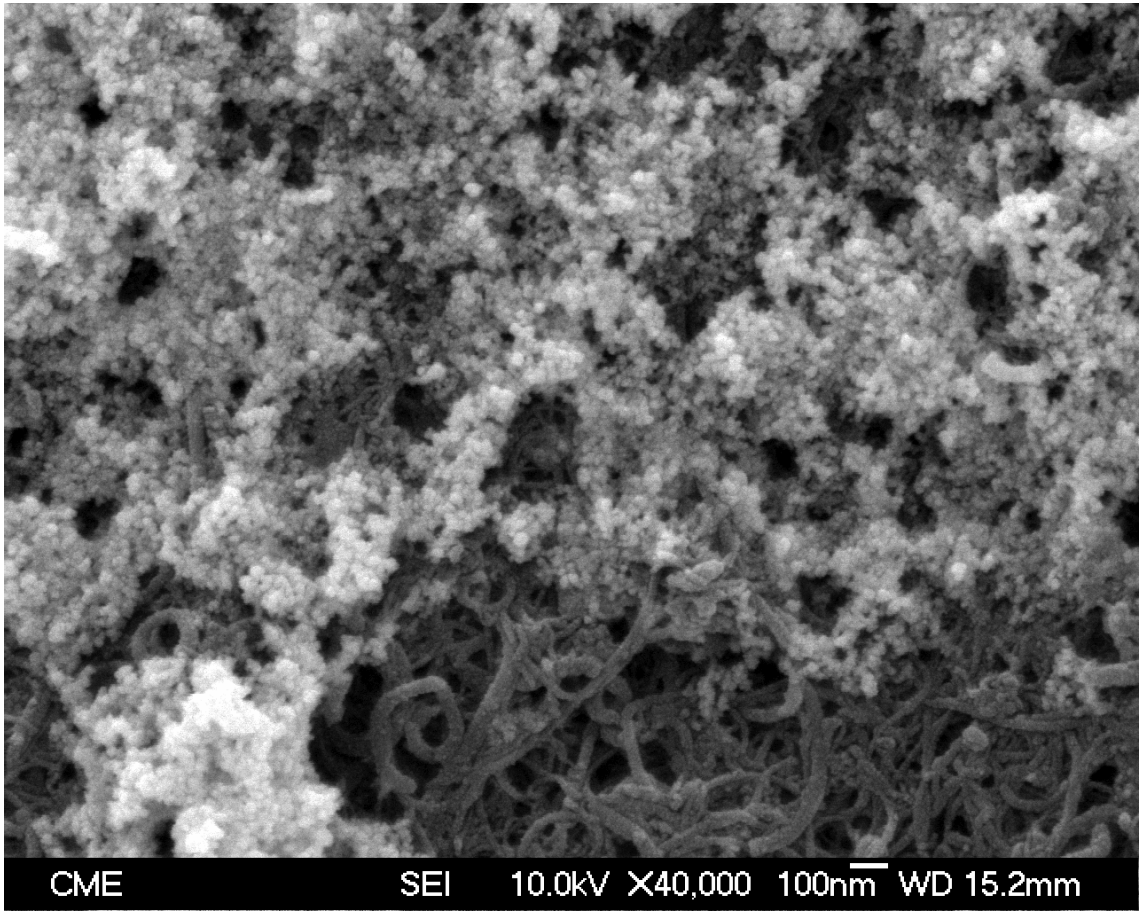
Analytical characteristics

Detection limit: 20 nM; Range of linearity: 50 nM - 10 µM. K_M = 21.9 µM
RSD = 3.1% for 10 measurements of 100 nM catechol using the same electrode; electrode-to-electrode reproducibility RSD = 8.8% (n = 10)

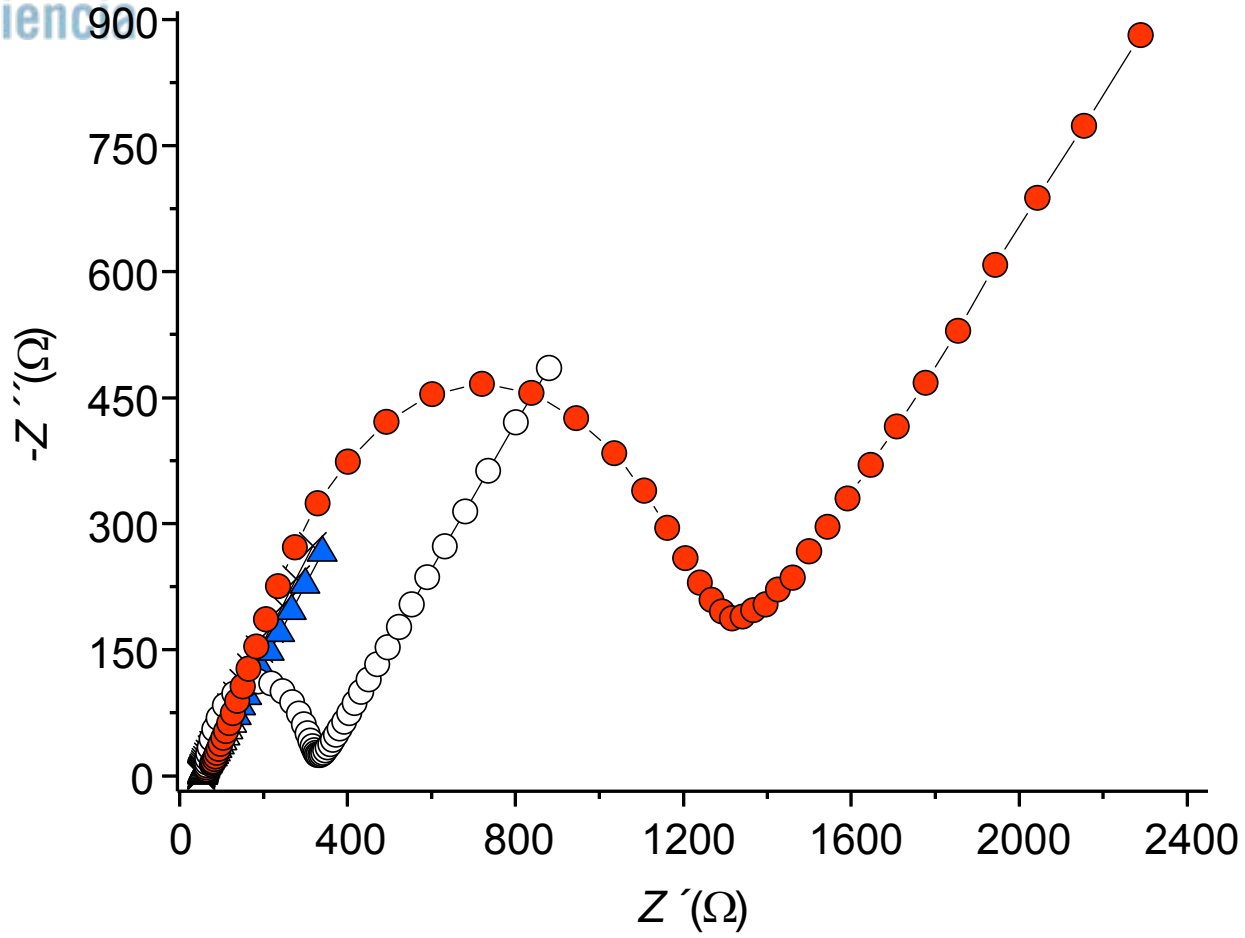

HAuCl4
SH
NH2
SH
HS(CH2)2SO3H
NaBH4 / DMSO
S(CH2)2SO3H
S
NH2
S
ELECTRO
POLYMERIZATION
SWNT
XO-CD
GCE
GCE/SWNT
GCE/SWNT/pAuNP
GCE/SWNT/pAuNP/XO-CD



HRTEM
4.9 ± 0.8 nm

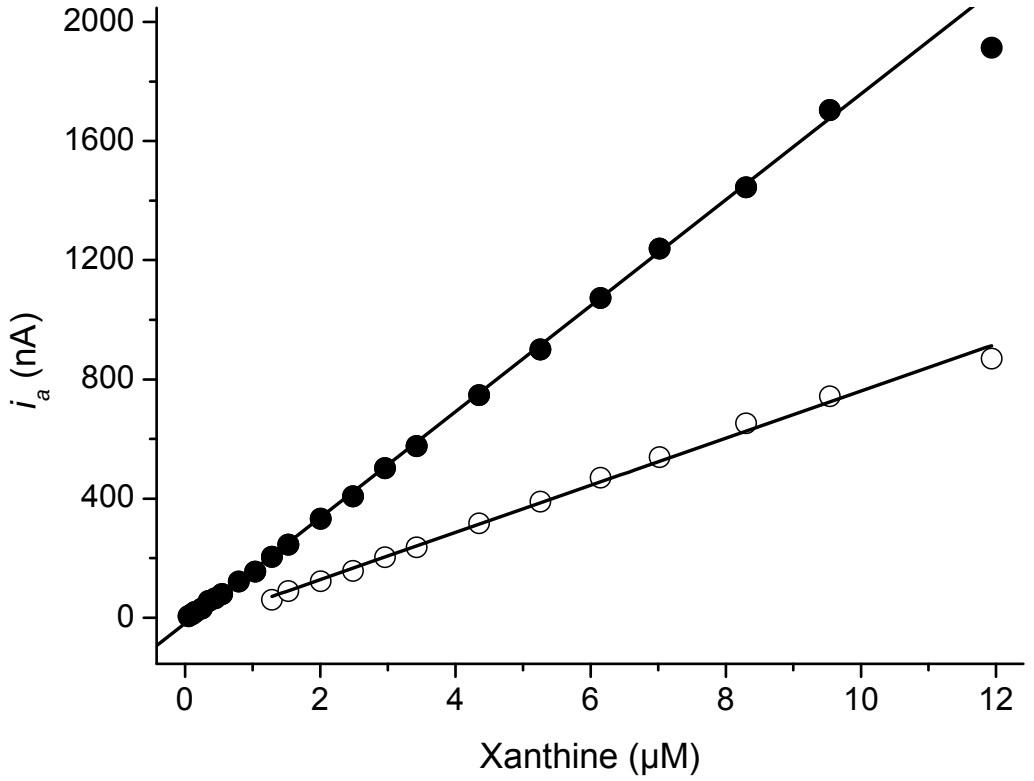


SEM



EIS,○) GCE; ▲) GCE/SWNT; X)GCE/SWNT/pAuNP; ●)GCE/SWNT/pAuNP/XO-CD
5 mM $Fe(CN)_6^{3-/4-}$

(●) XO-CD; (○) native XO



Sensitivity: 4.71 A/M

cm^2 (A= 4.1 mm^2)

Linear range: 50 nM – 9.5 μM

Limit of detection: 40 nM

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CONCLUSIONS

The use of bisaniline-cross-linked nanostructured networks of metal nanoparticles constitutes an excellent strategy to design scaffolds for the successful immobilization of redox enzymes to prepare mediatorless amperometric biosensors with improved analytical performance.

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