



Pain-Free Alpha-Synuclein Detection by Low-Cost Hierarchical Nanowire Based Electrode

Gisella M. Di Mari ^{1,2}, Mario Scuderi ³, Giuseppe Lanza ^{4,5}, Maria Grazia Salluzzo ⁵, Michele Salemi ⁵, Filippo Caraci ^{5,6}, Elena Bruno ^{1,2}, Vincenzina Strano ², Salvo Mirabella ^{1,2} and Antonino Scandurra ^{1,2,7,*}

¹ University of Catania, Department of Physics and Astronomy, "Ettore Majorana", via S. Sofia 64, 95123 Catania, Italy; gisella.dimari@dfa.unict.it; elena.bruno@dfa.unict.it; salvo.mirabella@dfa.unict.it

² CNR-IMM, Catania (University) UNIT, via S. Sofia 64, 95123 Catania, Italy; vincenzina.strano@ct.infn.it

³ CNR-IMM, VIII Strada 5, 95121, Catania, Italy; mario.scuderi@imm.cnr.it;

⁴ University of Catania, Department of Surgery and Medical-Surgical Specialties, Via Santa Sofia 78, 95123, Catania, Italy; giuseppe.lanza1@unict.it

⁵ Oasi Research Institute-IRCCS. Via Conte Ruggero 73, 94018, Troina, Italy; msalluzzo@oasi.en.it; msalemi@oasi.en.it

⁶ University of Catania, Department of Drug and Health Sciences, Via Santa Sofia 64, 95123, Catania, Italy; fcaraci@unict.it

⁷ Research Unit of the University of Catania, National Interuniversity Consortium of Materials Science and Technology (INSTM-UdR of Catania), via S. Sofia 64, 95125 Catania, Italy

* Correspondence: Correspondence: antonino.scandurra@dfa.unict.it

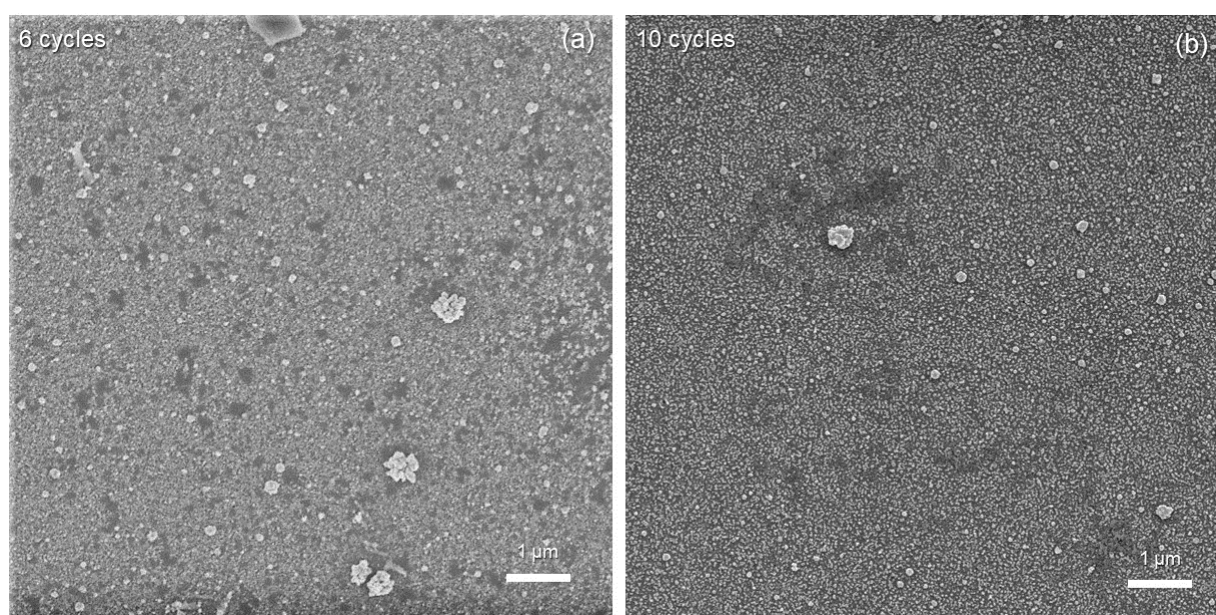


Figure S1. FESEM pictures of Au NPs obtained through electrodeposition, performing a) 6 CV cycles and b) 10 CV cycles, respectively.

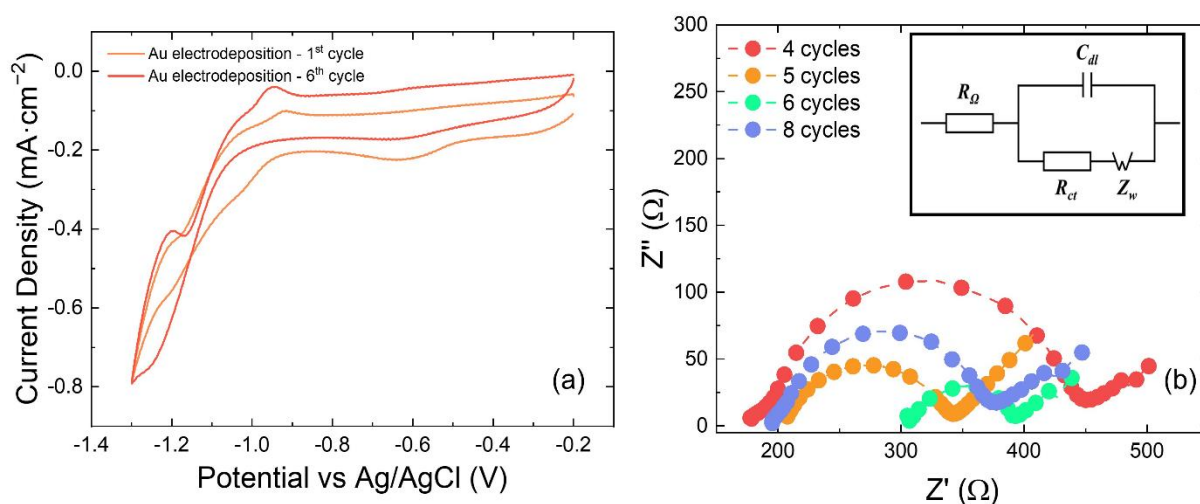


Figure S2. (a) Au electrodeposition first and sixth cycles; the electrodeposition was conducted in a 1mM HAuCl₄ solution in PBS by performing cyclic voltammetries, by sweeping the potential from -0.2V to -1.3V with a scan rate of 50 mV s⁻¹. (b) Experimental (dots) and simulated (dashed lines) impedance spectra (EIS) in the frequency range of 0.2 to 5·10⁴ Hz of Au NPs into ITO-PET, obtained at a formal potential of 0V. In particular, 4 (red), 5 (orange), 6 (mint), 8 (blue) cycles were evaluated. Inset: equivalent electrical circuit used for the EIS simulations.

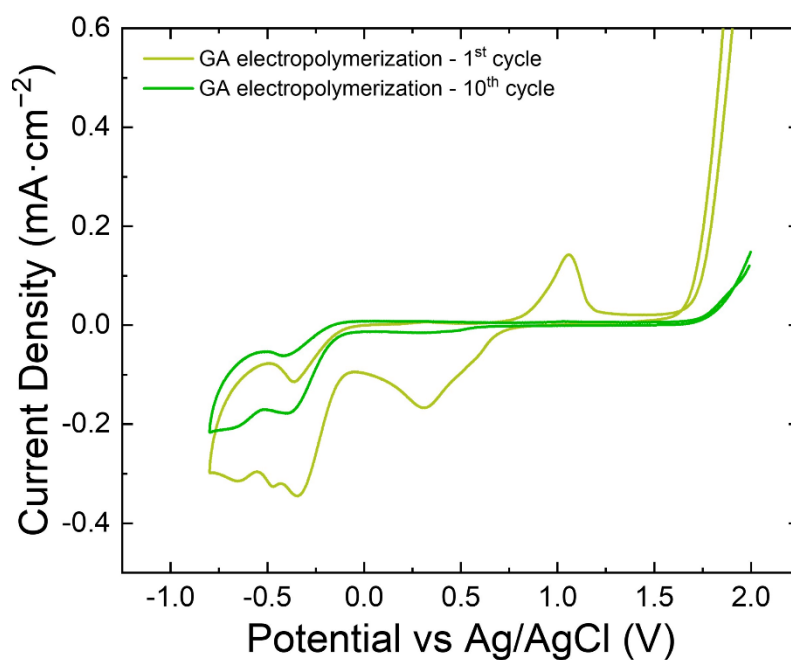


Figure S3. First and tenth CV cycles of GA electro-polymerization. The electro-polymerization was performed by cyclic voltammetry in a L-glutamic acid solution 0.01M in PBS, by executing 10 cycles in the potential range of -0.8V to 2V.



Figure S4. Optical picture of the whole electrode.

Electrochemical tests before and after α -synuclein immobilization

Figures S5 and S6 shows the CV curves and the experimental (dots) and simulated dashed lines) impedance spectra (EIS) in the frequency range of 0.2 to $5 \cdot 10^4$ Hz of four electrodes (S1-S4) before (empty circles) and after the α -synuclein immobilization step (full circles), at concentration of 0.5, 1, 3.5, and 10 $\text{pg} \cdot \text{mL}^{-1}$ in PBS solution. As a consequence of α -synuclein immobilization, the electrode was subjected to an increase in terms of R_{ct} . Similarly, both the anodic and cathodic peaks of the probe redox couple were subjected to a reduction in the current density as a function of the α -synuclein concentration and to a shift towards higher potentials, as reported in Figure S5.

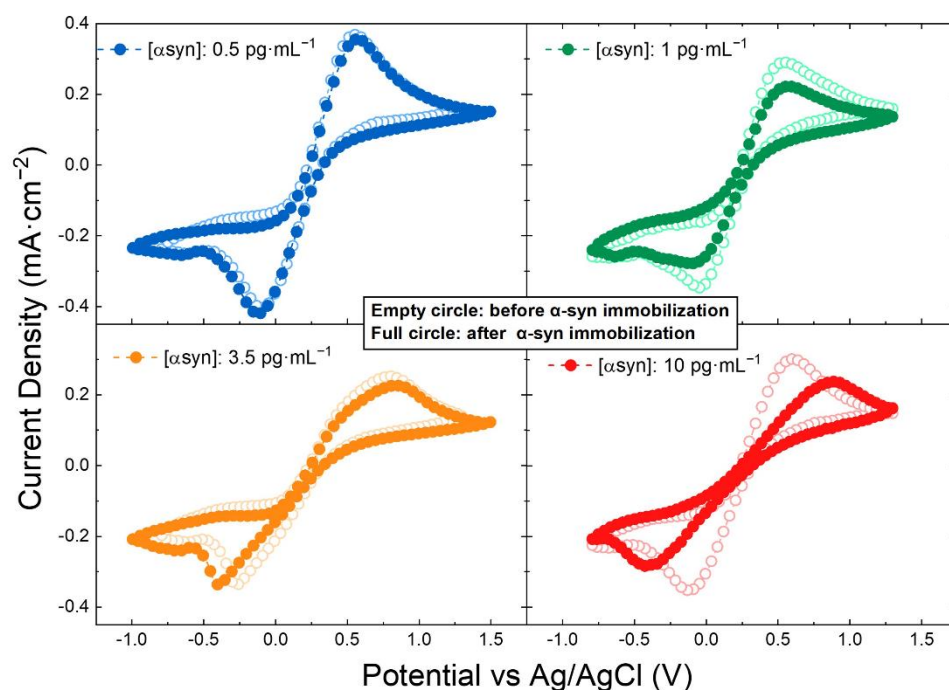


Figure S5. Cyclic voltammograms of the redox probe $\text{Fe(II)(CN)}_6^{4-}/\text{Fe(III)(CN)}_6^{3-}$ recorded before (empty circle) and after α -synuclein immobilization (full circle) at concentrations of 0.5, 1, 3.5 and $10 \text{ pg}\cdot\text{mL}^{-1}$ in PBS solution.

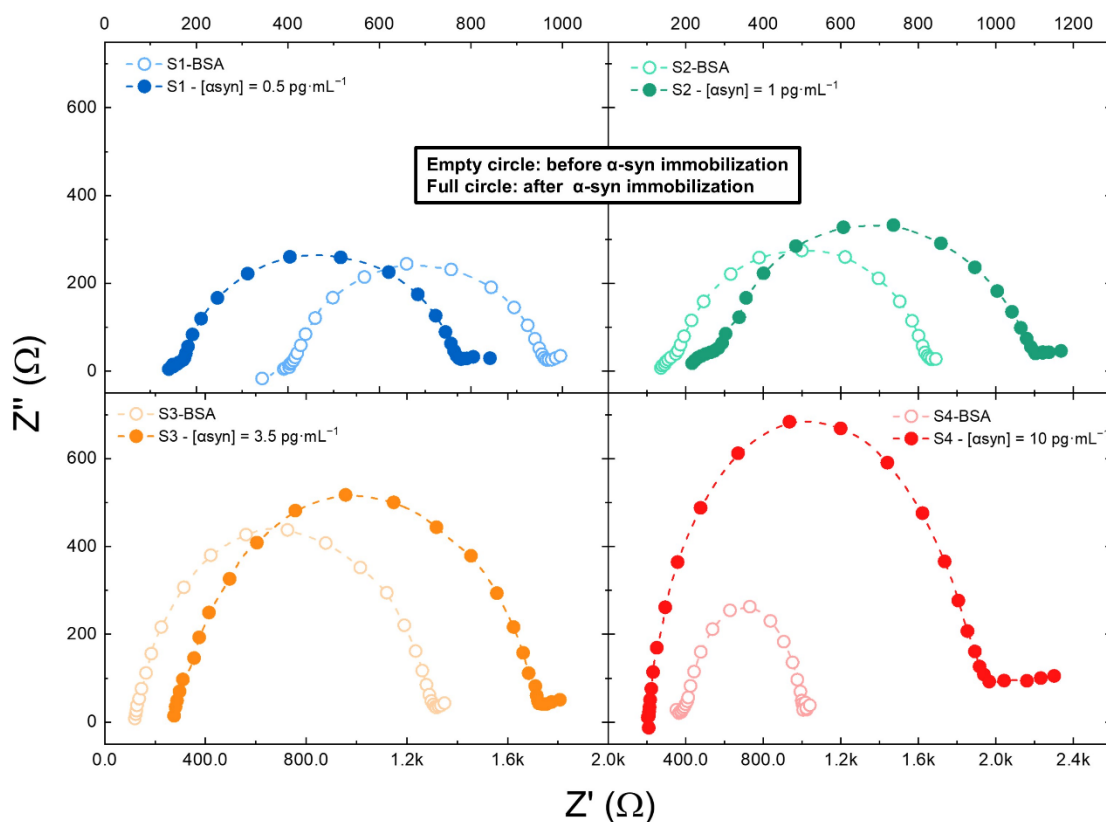


Figure S6. Experimental (dots) and simulated (dashed lines) impedance spectra (EIS) in the frequency range of 0.2 to $5 \cdot 10^4 \text{ Hz}$ of the electrodes recorded before (empty circles) and after α -synuclein recognition and immobilization (full circles), at concentrations of 0.5, 1, 3.5 and $10 \text{ pg}\cdot\text{mL}^{-1}$ in PBS solution.