# Robust electroactive substrates based on gold-nanoparticle arrays electrodeposited on indium tin oxide for reproducible surface-enhanced Raman spectroscopy

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Detection of low concentration of analytes up to the single-molecule level is becoming increasingly important in nanoscience and technology. Surface enhanced Raman spectroscopy (SERS) is a non-destructive and extremely sensitive technique able to detect trace amounts of substances, providing chemical information from the vibrational fingerprint of each molecule adsorbed on a rough metal surface [1–3]. Therefore, in biomedicine and biosensors SERS is becoming a prominent tool. One of the actual limitations of SERS is the lack of reproducibility of the Raman signal, because the substrates used to hold the molecules are not easy to reproduce in their detection ability [4]. In this work we have developed a conductive type of substrate for reproducible SERS measurements, following an easy and low-cost two-steps methodology. First, we deposit gold nanoparticles on a conductive indium-tin oxide (ITO) substrate by block-copolymer micellar lithography [5], creating a quasi-hexagonal pattern that acts as a template. In a second step, we overgrow these nanoparticles by applying an electrochemical pulse, taking advantage of the conductivity of the ITO. This last step allows for having bigger gold nanoparticles and consequently, smaller gaps between particles, thus increasing the amount of "hot-spots" in the entire surface. These "hot-spots" are responsible for the intensity enhancement of the Raman signal. Here we show that these electroactive substrates, apart from being an improved SERS tool, they can be also used to trigger electrochemical surface reactions. This opens new opportunities for a better understanding of the electrochemical reaction mechanisms in biochemistry, simultaneously allowing the in-situ monitoring.

## REFERENCES

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## FIGURES

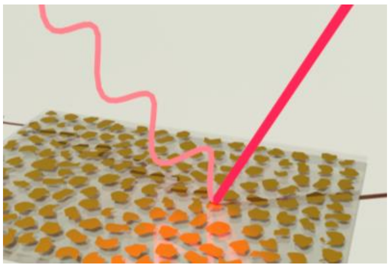

**Figure 1.** Schematic representation of ITO glass substrate with AuNPs growth by electrochemistry, illuminated by the Raman laser beam.

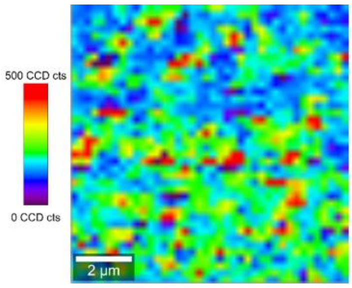


**Figure 2.** Raman mapping of an ITO substrate, functionalized with 4-MBA molecules, recorded with the 633 nm laser.