Amorphous carbon functionalised with silver nanoparticles based on metalorganic precursor for electrochemical detection of para-nitrophenol

Maxime Puyo[1] Emilie Lebon[1], Myrtil Kahn[1], Pierre Fau[1,2], Jérôme Launay[2], David Mesguich[3] and Katia Fajerwerg[1]

[1] *LCC-CNRS, Université de Toulouse, CNRS, UPS, Toulouse, France*
[2] *LAAS-CNRS, Université de Toulouse, CNRS, UPS, Toulouse, France*
[3] *CIRIMAT, Université de Toulouse, CNRS, Toulouse, France*
maxime.puyo@lcc-toulouse.fr

In the past 20 years, nanomaterials have been emerging as ideal candidates for sensing applications due to their high surface-to-volume ratio, small sizes and surface chemistry. Electrochemical sensors based on nanomaterials have proved their potential, allowing fast and label-free detection.

Silver nanoparticles (AgNPs), due to their high thermal and electrical conductivity, their use in surface enhanced Raman scattering ("SERS") and their catalytic properties are extensively studied. Many processes for the functionalisation of surfaces with silver nanoparticles have been described such as physical vapour decomposition, chemical, electrochemical or photochemical reduction of silver salts as a silver precursor [1,2]. However, very few paths are based on the mild decomposition of metalorganic silver precursors, which offers a simple access to the controlled deposition of nano-sized AgNPs on substrates.

Glassy carbon is widely used in electrochemistry due to its robustness, high electrical conductivity and wide electroactive potential range. Among carbon-based substrates, ultra-flat carbon films formed via the pyrolysis of photoresist resins films coated on a substrate have been highlighted recently [3]. This process allows to easily tune the thickness of the pyrolyzed polymer films ("PPF") and to pattern them *via* lithography.

Herein we describe an original one-pot method to decorate substrates with AgNPs. This process consists of the liquid-phase dihydrogen-assisted thermolysis of metalorganic silver precursors [4] (silver amidinates) in the presence of PPF substrates. This process allows to easily control the surface covering of the substrate by silver: from isolated nanoparticles to a complete film. Both pristine and silver-decorated PPFs topologies have been characterised by SEM and AFM analyses. PPF surface have been chemically characterized by Raman spectroscopy and the plasmonic properties of AgNPs. Based on their electrically conductive properties, PPFs and the nanocomposite silver-decorated PPFs have been used as working electrode for 4-nitrophenol sensing, used as a model pollutant.

References:
[1] K. Fajerwerg et al., *Electrochemistry Communications*, **12**, 1439 (2010).
[2] S. Ramanathan, S.C.B. Gopinath, *Microsystem Technologies*, **23**, 4345 (2017).
[3] K. Ounnunkad et al., *Faraday Discussions*, **199**, 49 (2017).
[4] B. S. Lim et al., *Inorganic Chemistry*, **42**, 7951 (2003).