

First Euro-Mediterranean Conference on Materials and Renewable Energies (EMCMRE-1) 21-25 November 2011

Self-organized gold nanoparticle modified HOPG as new electrode material for electrochemical nanosensing applications

Abdelhafed Taleb^a, Yanpeng Xue^a, Laurence Motte^b, Yohan Lalattone^{b,c}

^aLaboratoire d'Electrochimie, Chimie des Interfaces et Modélisation pour l'Energie

ENSCP, Chimie ParisTech, CNRS/UMR 7575.11 rue P. et M. Curie, 75231 Paris cedex 05 France

^blaboratoireBioMoCeTi UMR 7033 CNRS Université Paris 13, 74 Rue Marcel Cachin, 93017 Bobigny, France

^cService de médecine Nucléaire, Hopital Avicenne, 125 route de Stalingrad. 93009 Bobigny Cedex France.

E-mail : Abdelhafed.taleb@upmc.fr

Abstract

The environment and human health are affected by the toxicity of some compounds and elements at very low concentration. Heavy metal ions such as Cadmium, Mercury etc. have been a major concern throughout the world for several decades. As a result the development of sensing with high sensitivity has become very important. The emergence of nanoelectroanalytical chemistry as a new interdisciplinary field has motivated the scientific community to develop new electrode material designs for sensing applications with high performance in terms of sensitivity, selectivity, reliability, ease of fabrication and use and low cost. In this context the use of nanomaterials for new electrode material design is one of the most exciting approaches. Owing to their small size (high surface to volume ratio), nanomaterials exhibit unique properties which can be used to construct novel and improved sensing devices [1]. However, nanomaterials have been used to modify metal, glass or carbon in connection with electrochemical [1-9] and optical [10-15] sensing. Among the transduction methods developed, the electrochemical ones have optimized conditions for observing and controlling reactions on a microsurface and nanosurface level using miniaturized, portable devices [1-9].

The presented work shows the development of a working electrochemical sensor using a self-organized gold nanoparticle (Au NP) modified HOPG electrode. Au NPs were functionalized with bisphosphonate receptors which are efficient chelating agents of metal ions. To demonstrate the sensing performance of the prepared electrode, silver and copper metal ions were used as analysts. The obtained results show remarkable performance increases in terms of high sensitivity, high selectivity, easy surface regeneration and linear behaviour over a wide range of analysts' concentration. It is expected to extend this method detection to other metal analyst ions.

References

- [1] X. Luo, A. Morrin, A. J. Killard, M. R. Smyth, *Electroanalysis*, 18, 4 319, 2006.
- [2] J. Wang, *Anal. Chim. Acta*, 469, 63, 2002.
- [3] F. Lucarelli, G. Marrazza, M. Mascini, *Biosens. Bioelectron.* 20, 2001, 2005.
- [4] K. Kerman, M. Saito, S. Yamamura, Y. Takamura, E. Tamiya, *Trends in Analytical Chemistry*, 27, 585, 2007.
- [5] A. Merkoçi, *FEBS Journal* 274, 310, 2007.
- [6] M. T. Castaneda, S. S. Alegret, A. Merkoçi, *Electroanalysis*, 19, 743, 2007.
- [7] J. M. Pingarron, P. Yanez-Sedeno, A. Gorzalez-Cortes, *Electrochimica Acta*, 53, 5848, 2008.
- [8] Y. Y. Xu, C. Brian, S. Chen, S. Xia, *Anal. Chem. Acta*, 561, 2006, 48
- [9] C. Carralero, M. L. Mena, A. Gonzalez-Cortés, P. Yanez-Sedeno, J. M. Pingarron, *Anal. Chim. Acta*, 528, 1, 2005.
- [10] Y. L. Hung, T. M. Hsiung, Yi. Y. Chen. Y. F. Huang, C. C. Huang, *J. Phys. Chem. C*, 114, 16329, 2010.
- [11] A. Leung, P. M. Shankar, R. Mutharasan, *Actuators*, B 125, 688, 2007.
- [12] H. Huang, Y. Chen, *Biosens. Bioelectron.* 22, 644, 2006.
- [13] G. Proll, L. Steinle, F. Proll, M. Kumpf, B. Moehrle, M. MEHLmann, G. Gauglitz, *J. Chromatogr.*, A.1161, 2, 2007.
- [14] D. X. Hoa, A. Kirk, M. Tabrizian, *Biosensors and bioelectronics*, 151, 160, 2007.
- [15] N. Anker, J. rey; W. P. Hall, O. Lyandres, N. Shah, J. Zhao, P. Van Duyne, P. Richard, *Nature Materials*, 7, 442, 2008