Heat-treatments for carbon activation of commercial screen printed electrodes

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Screen printed carbon electrodes (SPCE) provide attractive opportunity for the development of miniaturized low cost electrochemical sensors. Screen printing process involves pressing different pastes or inks through a porous screen to transfer patterns on a substrate[1]. The process low cost and its compatibility for mass production make SPCEs the primary choice for researchers and diagnostic companies, particularly for electrochemistry driven applications. The great interest in the SPCEs is also due to attractive features of the carbon: chemically inert, low background currents and wide potential window [2]. However, these electrodes sometimes display low standard electrochemical performance due to non-electroactive components in the ink formulation and relatively low graphitic carbon content imposed by the constraints of screen-printing [3].
A straightforward heat treatment of commercial SPCE at different temperatures ranges is shown to produce at optimized conditions, considerable carbon activation. Electrode material was studied by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). Working electrode surface was observed by scanning electron microscopy (SEM). Voltammetric response of the heat treated SPCEs exhibited sharp increases in peak currents and lower peak-to-peak potential separation for a selection of analytes (hydroquinone, catechol, pyrogallol and dopamine). The main reasons for activation by temperature are believed to be due to an increase in the active sites density (as a consequence of exposure to oxygen atmosphere at relative high temperature), screen printing by-products degradation and exposure of fresh carbon.

References:
[1] J. P. Metters, R. O. Kadara, C. E. Banks, *An*alyst, 2011, 136, 1067–76.
[2] R. L. McCreery, Chem. Rev., 2008, 108, 2646–87.
[3] R. O. Kadara, N. Jenkinson, C. E. Banks, Sensors Actuators B Chem., 2009, 138, 556–562.

Aknowledgements:
Thanks are due to FCT (Fundação para a Ciência e Tecnologia) and FEDER (European Fund for Regional Development)-COMPETE-QREN-EU for financial support to the Research Centre, CQ/UM [PEst-C/QUI/UI0686/2011 (FCOMP-01-0124-FEDER-022716)]. Financial support from CRUP Acção Integrada Luso-Espanhola (E-136/2012). E. Gonzalez-Romero thanks the Spanish Ministerio de Economia y Competitividad (MINECO) - International Projects - Mobility (PRI-AIBPT-2011-1096 and CTQ2011-28157). Colloid Chemistry Group (UVigo) aknowledges financial suport from MINECO (CTQ2011-23167) Vanesa López-Puente thanks the MINECO for her PhD Grant (MAT2010-15374). Rui Gusmão thanks FCT for the PostDoc Grant (SFRH/BPD/86690/2012).