Reaction of the electrogenerated superoxide species with binding-materials in commercial Pt screen-printed electrodes, and its implication in amperometric O_2-gas sensing.

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Abstract

Screen-printed electrodes (SPEs) are low-cost, disposable sensing surfaces that have been widely used in applications such as glucose biosensing and heavy metal detection since the 1990s. However, despite their widespread use, there is still relatively little fundamental understanding of analyte redox behaviour at these surfaces. One advantage of these integrated electrodes devices is the requirement of only small volumes (typically μL) of electrolyte solutions, thus saving costs, improving response times, and opening up the potential for further miniaturization and implementation as sensor arrays (such as electronic noses or tongues). In this presentation the suitability of SPEs with room temperature ionic liquid (RTIL) solvents has been investigated for oxygen detection on commercially available platinum SPEs. Eight RTILs were examined. Cyclic voltammetric wave shapes were found to be significantly different on Pt SPE surfaces compared to conventional solid Pt macroelectrodes, suggesting a possible reaction of the electrogenerated superoxide with the compounds that make up the ink/paste of the SPE surface. The only RTIL that did not show such drastically different voltammetry was one that contained a pyrrolidinium cation, suggesting a more chemically stable solvent environment compared to the other imidazolium and phosphonium cations studied. The analytical utility was then studied on four SPE surfaces (carbon, gold, platinum and silver) in two RTILs (one with a pyrrolidinium and one with an imidazolium cation) and linear responses were observed between current and % concentration in the range 10–100% O_2. This suggests that SPEs may indeed be suitable for oxygen sensing in some RTILs, but significantly more pre-treatment of the surface is required to obtain reliable results. However, the reaction of superoxide with the SPE ink, together with a noticeable deterioration of the signal over time, suggests that this type of sensing platform may only be suitable for "single-use" oxygen sensing applications.[1] Research is currently underway to investigate ways in which to improve the robustness and performance of these low-cost devices for the detection and sensing of oxygen gas.

[1] Lee, J.; Murugappan, K.; Arrigan, D.W.M.; Silvester, D.S. *Electrochim. Acta*. In press *(http://dx.doi.org/10.1016/j.electacta.2012.09.104)*