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Electrochemical sensing of phenols on flat carbon surfaces functionalized with different chemical groups

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Graphene oxide is an interesting material for (bio)sensing[1], thanks to its tunable electrical conductivity and surface. It is very easy to tune its surface chemistry by varying the amount of epoxy, hydroxy and carboxy groups. Though, this rich surface chemistry makes also very difficult to understand the role of each functional group[2].
In this work, we tried to tackle this problem by creating thin layers of GO on otherwise perfect substrates of highly oriented pyrolitic graphite (HOPG). We compared the properties of pristine HOPG with activated HOPG (namely $HOPG_{act}$), prepared following an electrochemical procedure previously described[3], that consist in an oxidation in an acidic medium that leads to the formation of hydroxyl, carbonilic and carboxyl groups, for the oxidative sensing of phenol derivatives.
Phenols are an important class of organic compounds that can be found in different environments: they occur in foodstuff and plants (i.e. polyphenols) but also in drugs of abuse (e.g. morphine and cannabinoids).
We first characterized HOPG and $HOPG_{act}$ surfaces by atomic force microscopy (AFM), X-rays photoemission spectroscopy (XPS) and cyclic voltammetry (CV) measurements using a common redox probe, namely 1,1'-ferrocenedimethanol.
We then compared the performance of HOPG and $HOPG_{act}$ in CV sensing of three benzenediols isomers, namely hydroquinone, cathecol and resorcinol. The results obtained showed a significant difference between HOPG and $HOPG_{act}$ in sensing of hydroquinone, due to the –OH and C=O residues present on the latter, while no difference was found for cathecol and resorcinol. We are also using a similar approach to study the sensing of morphine and gallic acid (work in progress).

References

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