Catalytic CVD synthesis of a graphene-based microelectrode as a biosensor

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The oxidative stress is a biological process which is suspected to be related to the early stages of serious pathologies such as cardiovascular and neurodegenerative diseases or cancers. Thus, the development of reliable sensors for the monitoring of biomarkers involved in oxidative stress could prevent the development or early detect such pathologies.

Among them, electrochemical sensors present advantages such as accuracy, reliability and low cost. In this way the electrode surface functionalization must be treated with great attention, since it will influence the sensor lifetime, sensitivity, selectivity and limit of detection. Glassy carbon is today frequently used, but this material is hardly compatible with silicon technologies required to mass-produce integrated microcells.

Two-dimensional materials have emerged as rapidly rising stars in the field of nanotechnology. Indeed, graphene exhibits exceptional properties in terms of mechanical resistance, conductivity, high-surface area or electrochemical stability. In the present work, graphene is synthesized by catalytic chemical vapour deposition (CVD) on large-scale area (Fig. 1). Platinum, under the form of either foil or thin film deposited onto oxidized silicon wafer, is utilized as catalyst whereas methane is used as carbon feedstock. The graphene deposition has been performed at 1,040°C at atmospheric pressure, in a home-made reactor. The resulting graphene layer has been analyzed by scanning and transmission electron microscopies as well as by Raman spectroscopy.

The graphene-based electrode has subsequently been functionalized by electrografting of 4-thiophenylbenzene diazonium combined with electropolymerization of EDOT. The electrochemical characterization shows a high selectivity during the simultaneous detection of ascorbic acid and uric acid (Fig. 2).

These preliminary results open an interesting way of using graphene-based electrode with respect to silicon micro-technologies compatibility, for a low-cost and mass production of integrated micro-electrodes.

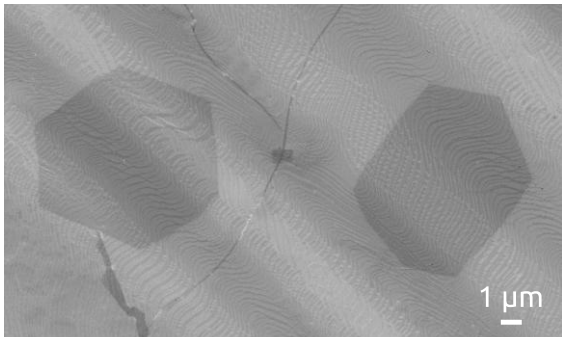

Figure 1- Graphene flakes synthesized by CVD onto platinum surfaces.

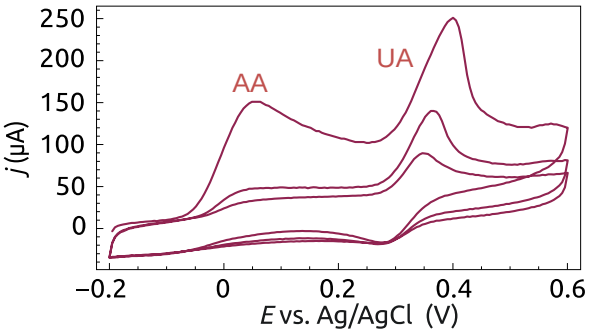

Figure 2- Detection of ascorbic acid and uric acid by cyclic voltammetry in phosphate buffer electrolyte.