

## Dispersible composite of exfoliated graphite and polyaniline with improved electrochemical activity for sensor applications

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The combination of conducting polymers with carbon materials possesses a fabrication of new composite materials having physic-chemical properties arising from the both components. Due to similar nature of the conjugation structures of carbon materials and conducting polymers some of these properties can be enhanced due to synergetic effect occurs in the composites. Polyaniline (**PANI**) is one of the most studied intrinsically conducting polymers with excellent environmental stability, good electrical conductivity and the possibility of chemical modification.

In this work, we report the synthesis of a dispersible composite material consisting of PANI and the exfoliated graphite platelets of either the graphite or the graphene grade (Figure 1). The properties of the composite material - such as solubility - are mostly determined by PANI and the FTIR and Raman spectra are dominated by the conducting polymer bands.

Cyclic voltammetry (**CV**) with the use of the ruthenium and iron couples (pH 9.5 and pH 7.8, respectively) has shown that the composite materials are electroactive at alkaline pH in contrast to conventional PANI prepared without graphene or graphite. This indicates that the graphene/graphite platelets form electrically conducting network within the PANI matrix (Figure 2).

This composite material is readily dispersible in *N*-methylpyrrolidone and it can be therefore casted or printed onto a substrate or an electrode and further used as an ion-to-electron transducer in solid-contact ion-selective electrodes or as an indicator electrode for the detection of biological molecules. We show that the incorporation of graphene or graphite platelets in the composite materials improved the electroactivity of the PANI-graphene/graphite composites at pH ≤ 10 in contact with aqueous electrolyte solutions. The CVs revealed also that the voltammetric current response of the composite materials was three times higher than for conventional PANI in ascorbic acid solutions (Figure 3).

## Figures

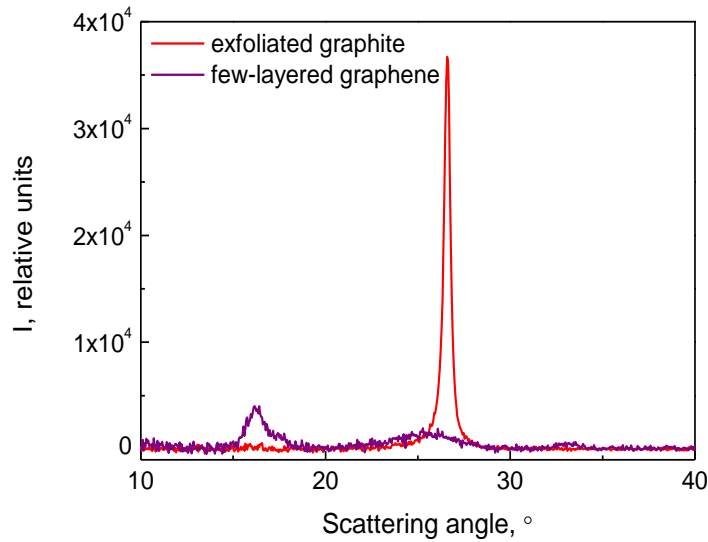


Figure 1. XRD pattern of the exfoliated graphite of the graphite and the few-layered graphite grades

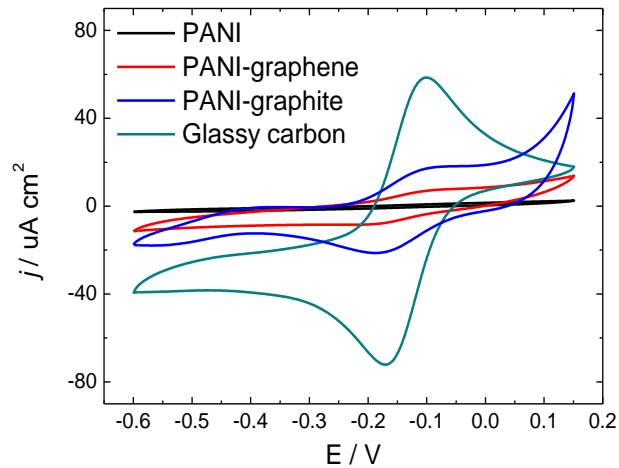


Figure 2. The cyclic voltammograms of the conventional PANI, PANI-graphene and PANI-graphite films casted onto glassy carbon electrode (GCE), and the bare GCE in 1 mM  $[\text{Ru}(\text{NH}_3)_6]\text{Cl}_2$  with 0.1 M  $\text{KNO}_3$  as the background electrolyte at pH 9; Reference electrode: Ag/AgCl; Counter electrode: GCE; Scan rate: 50 mV/s

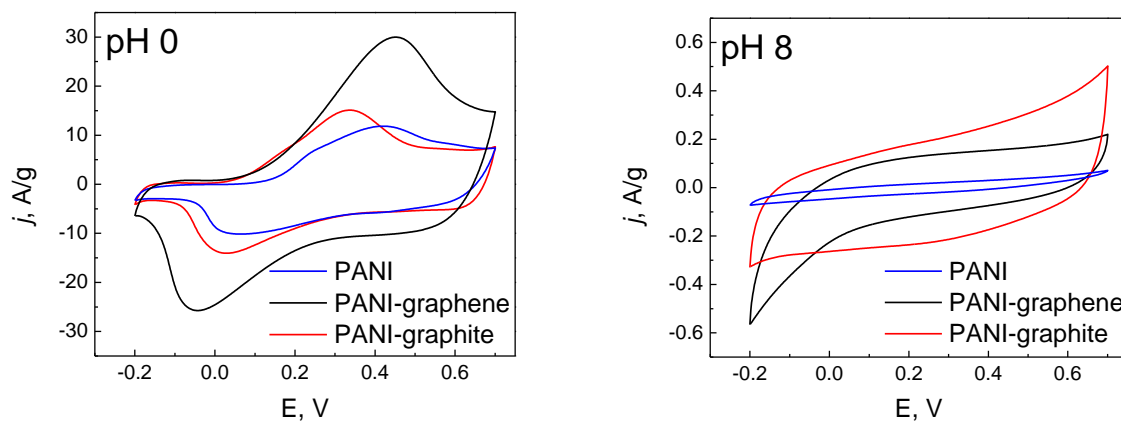


Figure 3. The cyclic voltammograms of the conventional PANI, PANI-graphene and PANI-graphite films at different pH. Reference electrode: Ag/AgCl; Counter electrode: GCE; Substrate:  $\text{SnO}_2$ -glass with 15 nm layer of Pt. Scan rate: 50 mV/s