Application of poly(folic acid) for pH detection

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Introduction

Many chemical processes are pH dependent and because of that its monitoring is very important. When glass electrodes for pH measurement cannot be used other methods are required. One of such methods to determinate hydrogen ions is use pH-sensitive conductive polymer modified electrodes [1].

Conducting polymers belong to polyenes or polyaromatic classes. Some have unique conduction mechanisms and are stabile in air [2]. Using the electrochemical synthesis these polymers can be directly deposited as a film on electrode substrate. To develop sensors, conductive polymers used most often are poly(1,5-diaminonaphthalene), terthiophene carboxylic acid, polyaniline, polypyrrole, etc. [3].

The aim of this work is to create a sensor to monitor pH in washing systems of food industry. In order to achieve this aim, chitosan drop coated pyrolytic graphite electrode was further modified with electrochemically polymerized folic acid [4]. Resulted sensor stability was tested in buffer solutions of pH 7 and 8 using cyclic voltammetry and chronoamperometry.

Electrochemical polymerization of poly(folic acid)

In order to create sensor for pH monitoring pyrolytic graphite electrode (PGE) was coated with folic acid (FA) polymers (PFA) using cyclic votammetry (CV). **PFA was polymerised on bare PGE and on chitosan (Ch) coated PGE.**
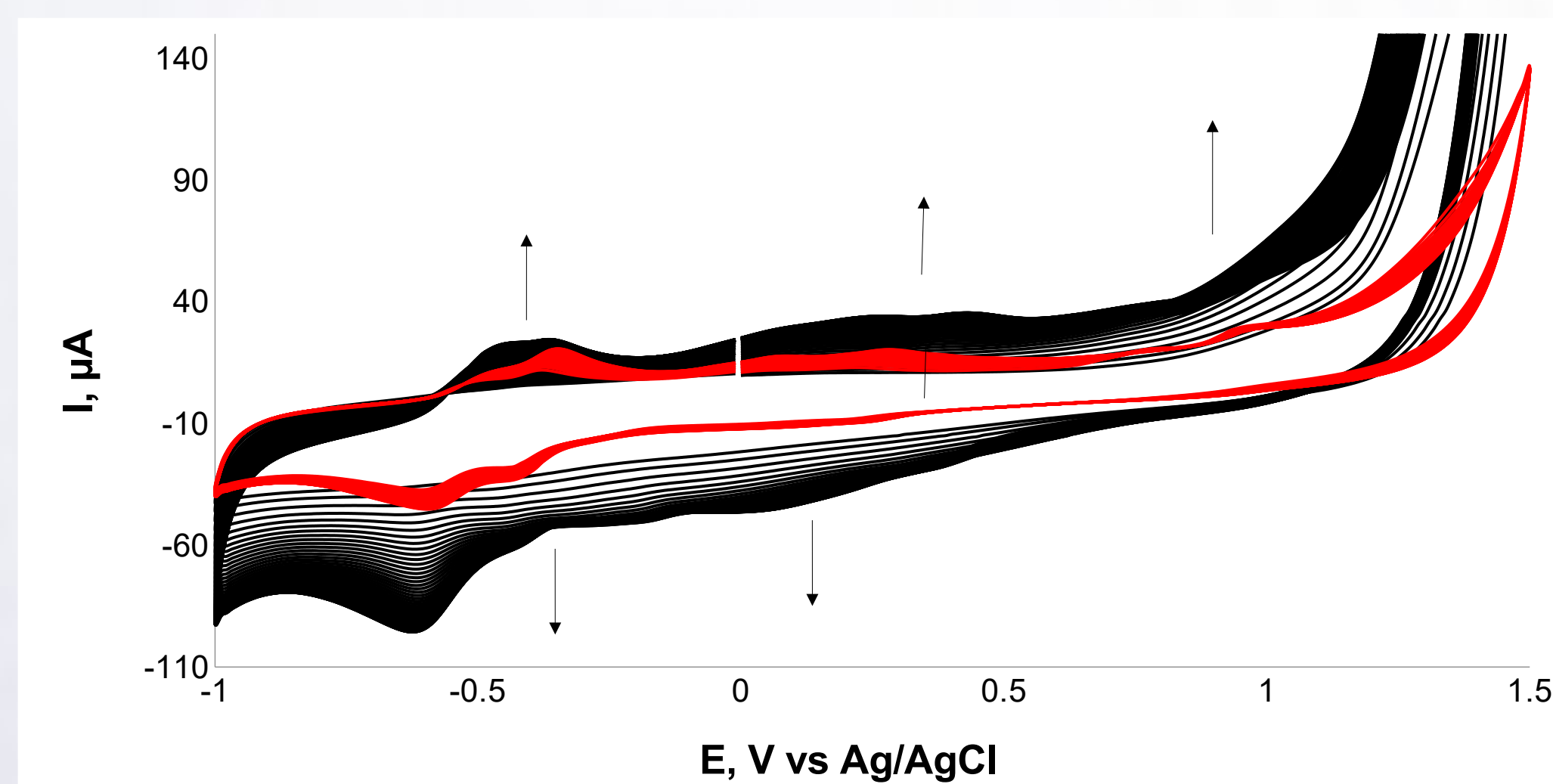

Fig. 1. CVs of electropolymerisation of **FA at PGE** (red lines) and at **PGE, coated with 1 % Ch solution in 1 % acetic acid** (black lines) from 1 mM FA in 0.1 M PBS, pH 6.0.
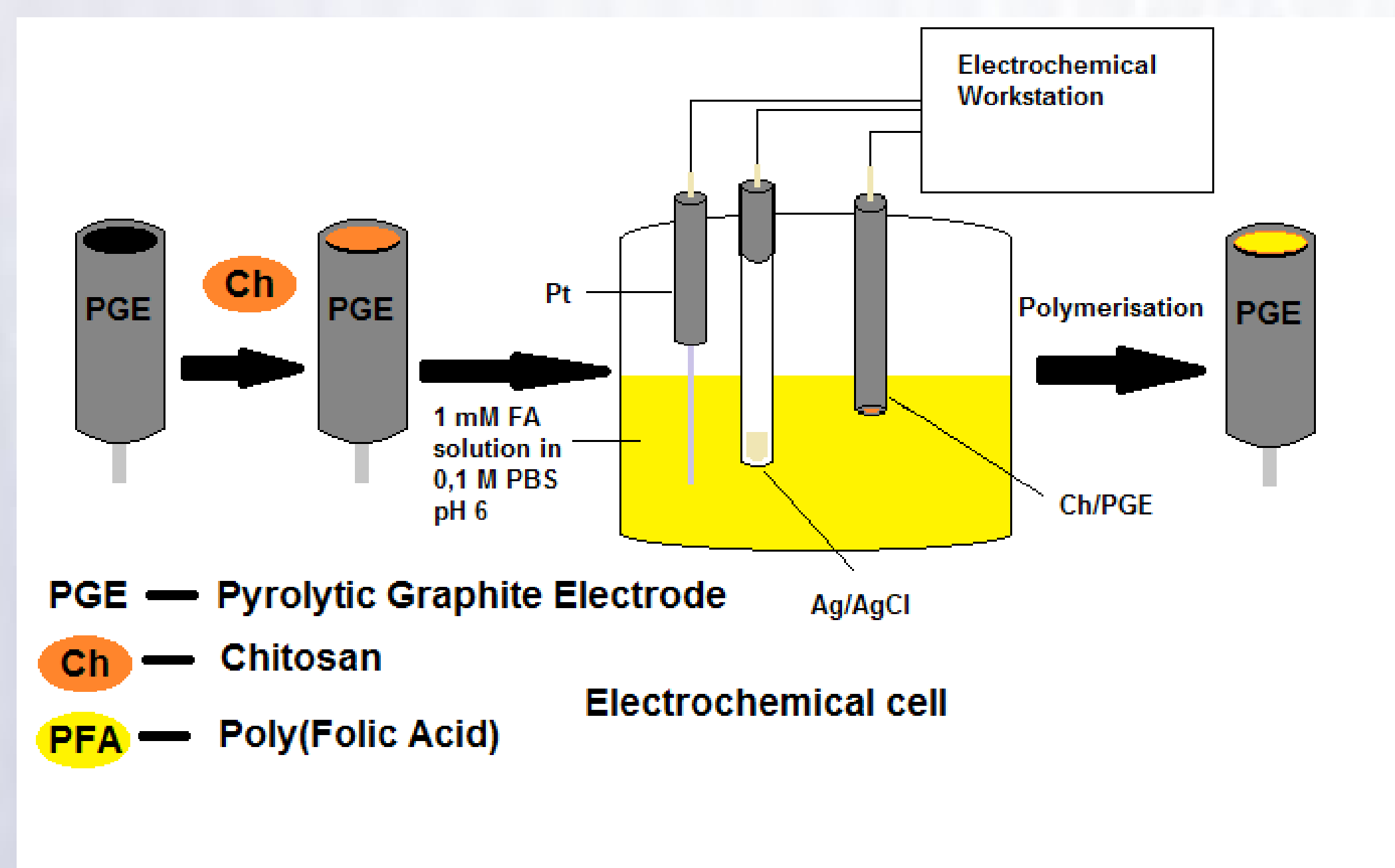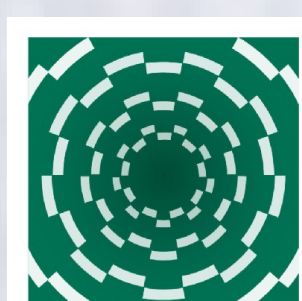

Fig. 2. PFA/Ch/PGE preperation. Bare PGE drop coated with 1 % Ch solution in 1 % acetic acid and left to dry for 1 day. Prepared Ch/PGE imersed in electrochemical cell with 1 mM FA in 0.1 M PBS, pH 6.0. Using CV electropolymerisation Ch/PGE coated with PFA.
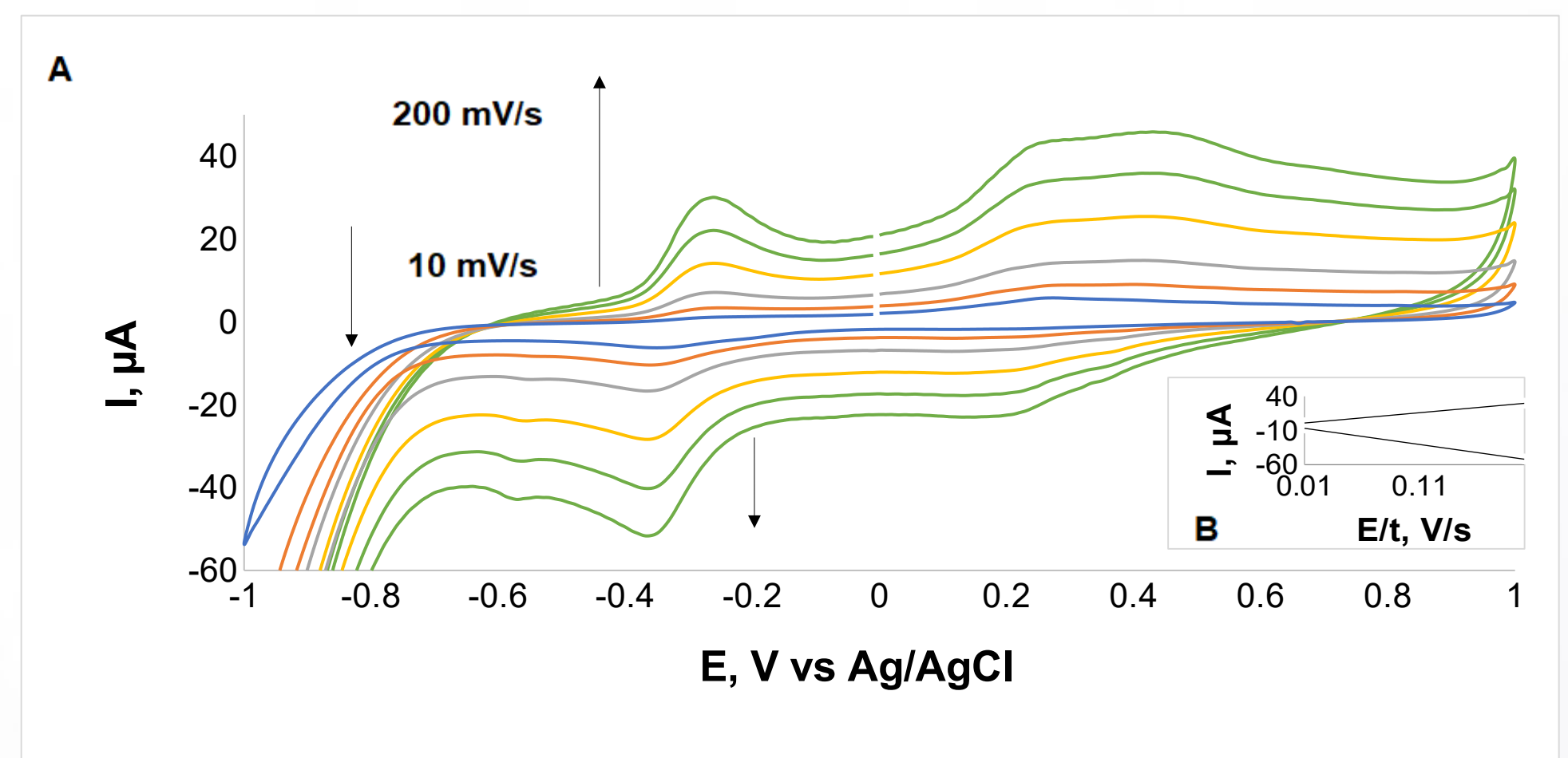
Acknoweledgement

Fig. 3. CVs of PFA/Ch/PGE in 0.1 M KCl pH 2 at different scan rates: 10, 25, 50, 100, 150, 200 mV/s (A). Plots of the peak currents versus the scan rate calculated from CVs (B).
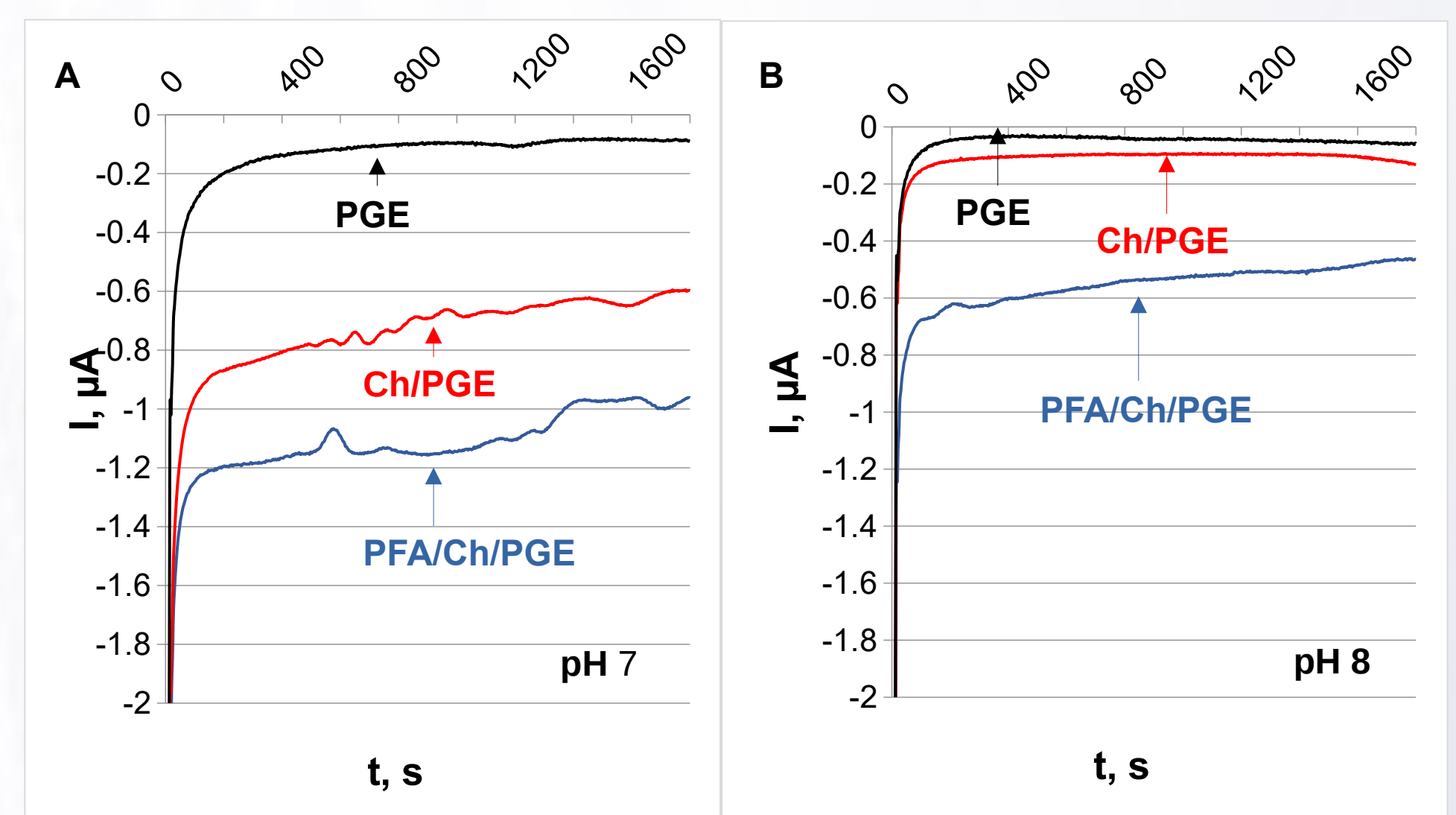
Poly(folic acid) electrochemical stability

Fig. 4. Chronoamperograms changes at PFA/Ch/PGE. Supporting electrolyte: 0.1 M PBS pH 7.0 (A) and 0.1 M PBS pH 8.0 (B); the potential -0.5 V, scaning time 30 min.
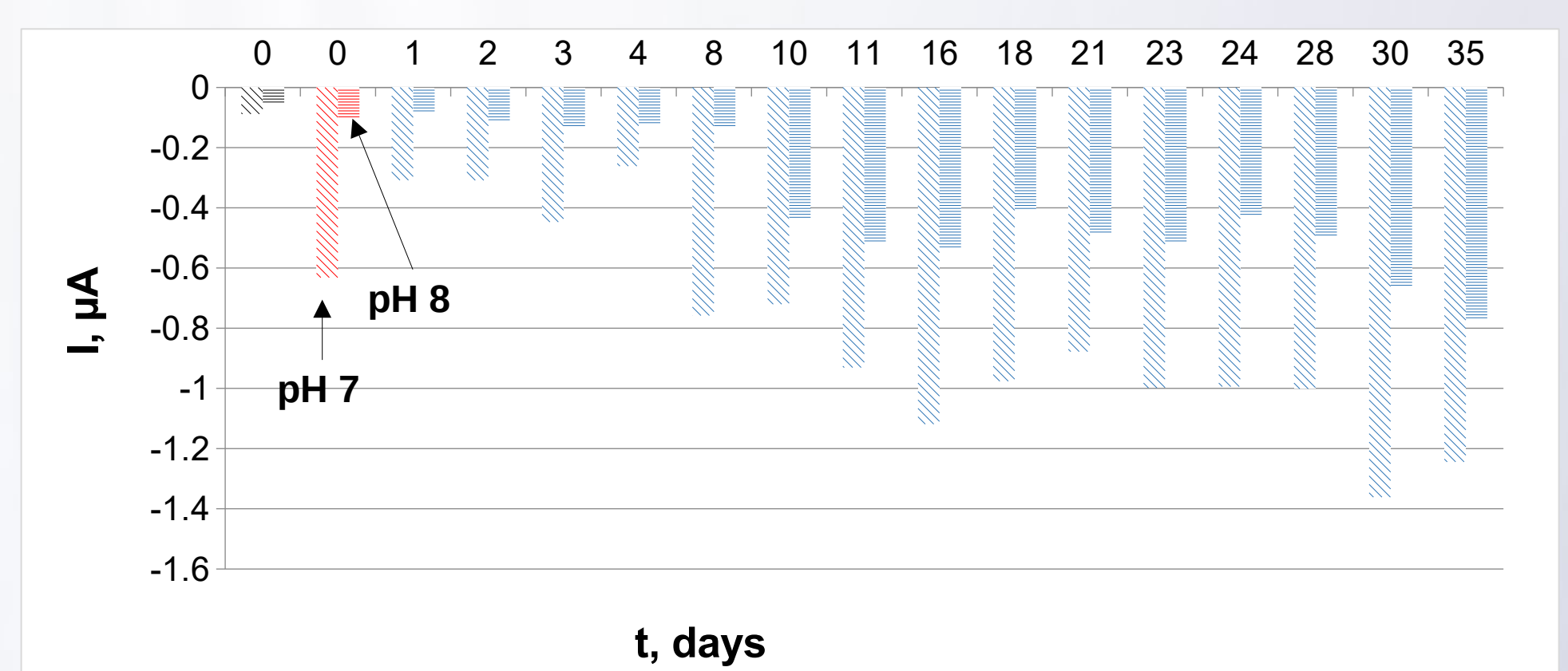

Fig. 5. Stability of PFA obtained from chronoamperograms in 0.1 M PBS solutions of pH 7 and 8. Black bars show only **PGE**, red – **Ch/PGE**, blue – **PFA/Ch/PGE**.

Conclusions

1. PFA polymerisation is better at Ch/PGE than that at bare PGE.
2. Electrochemical redox process at PFA/Ch/PGE is adsorbtion-controlled.
3. PFA/Ch/PGE is more sensitive to pH than bare PGE or Ch/PGE.
4. PFA/Ch/PGE response current to pH stabilizes after 10 days and maintain stability at least 35 days.

References

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