Electrochemical investigation of redox transitions during complexation process in Cu-Cysteine system

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Cysteine (Cys) provides convenient CuNPs synthesis route and may serve as a multipurpose synthesis and stabilizing agent. Electrochemical behavior of copper in 0.5M H_2SO_4 in presence of cysteine has been investigated and kinetic regularities of the complexation process in Cu-Cys system have been determined.

Experimental results obtained using cyclic voltammetry (CV) method showed that after each cycle of polarization, a gradual drop in current density may be observed in the potential range of active metal dissolution that is attributed to formation of Cu-Cys complexes that affects further ionization process (Fig. 1).
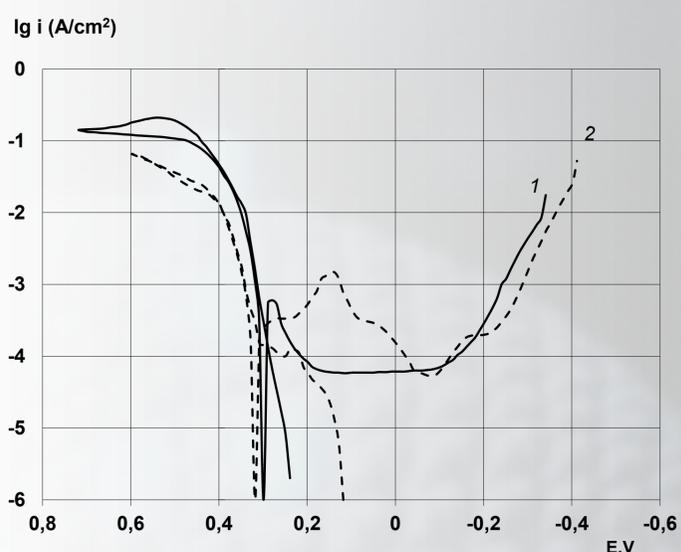
Fig. 1 – Anodic-cathodic polarization curves on cupper electrode in:
1 – H_2SO_4; 2 - H_2SO_4+ cysteine (0,0165 mol/l)
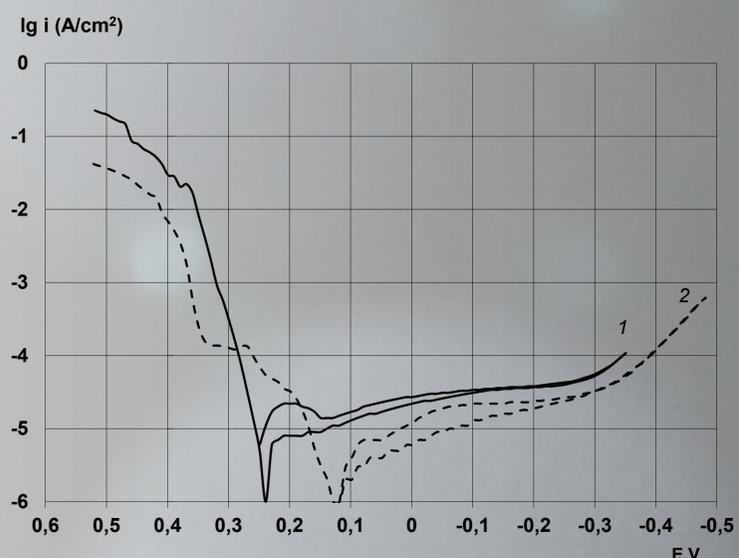
Fig. 2 – Cathodic-anodic polarization curves on cupper electrode in:
1 – H_2SO_4; 2 - H_2SO_4+ cysteine (0,0165 mol/l)

On the cathodic portion of polarization scan in presence of Cys the additional current peaks may be observed compared to blank solution. Strong prolonged wave in range 0.28 -0.05V, reaching peak value at 0.15V associated with complexes discharge in addition to Cu cations discharge while reverse polarization scan does not show signs of such discharge processes on the first pass due to lack of metal ions (Fig. 2). Noticeable cathode peak near -0.15V may be attributed with cysteine-cystine transition.

Potentiostatic electrochemical studies for potentials 0.5, 0.4, 0.25, 0.15, 0.03, -0.19 and -0.07V coupled with the surface morphology analysis enabled to assess the time-dependent parameters for the complexation process and also confirmed that the potential range for the complexation process matches one for the potentiodynamic regime. Understanding redox states and transitions in such systems is a key for the development of new efficient synthesis routes for novel nanocomposite materials.