Fig. 2. Raman spectra of activated carbon.

The typical Raman spectrum of graphene exhibits three peaks: peak *D* at 1351 cm^{-1}, peak *G* at 1580 cm^{-1}, and peak *2D* at 2700 cm^{-1}. The ratio between the intensities of peak *G* (I_G) and peak *2D* (I_{2D}), I_G/I_{2D} gives an estimate of the number of layers [22]. Analysis of Raman spectra (Fig. 2) of carbon material obtained from activated RH showed the content of graphene films with three or more layers (I_G/I_{2D} = 0.63; 0.50; 0.43; 0.30).

The kinetics of electroreduction of gold on a platinum surface from chloride electrolytes by the cyclic voltammetry (CV) with variation of the scan rate in the range of 10–50 mV s^{-1} has been studied. Chronoamperometric (CA) measurements were performed at the potential of +0.2 V vs. Ag/AgCl with varying gold concentration and in the temperature range from 288 K to 308 K.

Cyclic voltammograms were obtained in the study process of gold electroreduction on a platinum electrode from chloride solutions (Fig. 3). As can be seen from Fig. 3, the cathode peak corresponds to reaction (1), the anode peak corresponds to the oxidation of gold to Au^{3+}. Complete electroreduction of gold ions proceeds at a potential greater than $E_{p\ (c)}$, and electrooxidation at a more positive potential from 800 mV. An increase in the potential scan rate from 10 mV s^{-1} to 50 mV s^{-1} leads to an increase in the cathodic peak current density (i_{pc}) and a shift in the recovery peak

potential ($E_{p(c)}$) of gold to the cathode region. The dependence of the values of the current density peaks on the square root of the potential scan rate ($\sqrt{v}$) is linear (Fig. 3 Inset) and passes through the origin, which indicates the diffusion nature of the process.

The shift in the peak potential of the gold recovery depends on the concentration of gold ions in the solution (Fig. 4). An increase in the gold concentration from 7.65 to 80.79 mg L^{-1} at a potential scan rate of 10 mV s^{-1} causes a shift in the potential of the peak of gold ion reduction on the Pt electrode by 300–400 mV. The use of electrolytes with a high concentration of the potential determining ions leads to an increase in the potential difference between the reduction of gold and electronegative impurities, such as Cu, Ag, etc.

The dependence of i_{pc} on $\sqrt{v}$ presented below was calculated on the basis of the Randles-Ševčik equation, while the diffusion coefficient of Au^{3+} ions was calculated at various concentrations (Table 1). For reversible processes, the relationship between the current density of the electroreduction peak and the potential scan rate was described by the Randles-Ševčik equation [23].

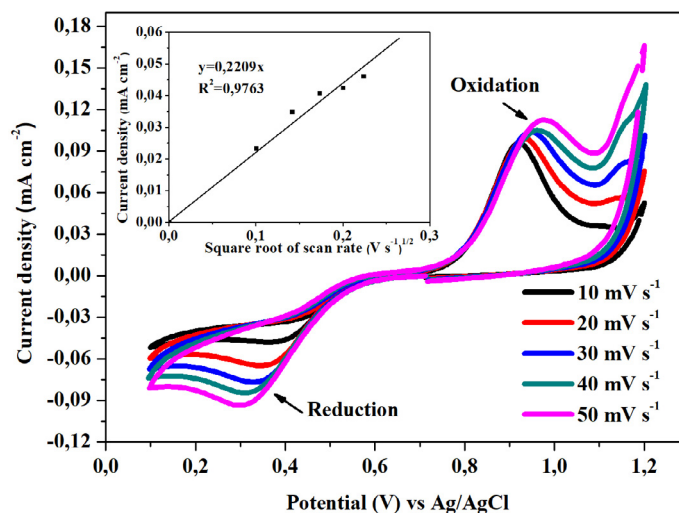$$i_p = 0,4463 \left(\frac{F^3}{RT} \right)^1 Â \cdot n^3 Â \cdot AÂ \cdot D^1 Â \cdot CÂ \cdot v^1 \tag{3}$$

Fig. 3. Cyclic voltammograms of electroreduction of gold on a platinum electrode in the solution of 80.79 mg L^{-1} HAuCl$_4$ + 0.1 mol L^{-1} KCl at various scan rates, T = 298 K; Inset: the dependence of the peak current density (i_{pc}) related to the cathode processes on the square root of the potential scan rate.