



Fig. 6. SEM images at different magnifications (a, b) and elemental analysis (c) of the carbon electrode surface after deposition of gold.

be seen as separate particles in the microimages (Fig. 6a,b). It is still an open question of why they are agglomerated. Elemental analysis by Energy Dispersive X-ray Analysis was carried out to verify the fact that those bright particles are gold (Fig. 6c). Using this method, it is possible to obtain gold nano- and submicron particles and gold can be extracted (recovered) from production waste.

4. Conclusions

Within the framework of this work, the electroreduction of Au^{3+} ions on activated carbon and gold electrodes was investigated. Using the piezo-quartz microbalance method in combination with voltammetry, the number of electrons participating in the reaction were determined. It was also found that electroreduction of gold goes via the discharge of AuCl_4^- complexes to the formation of metallic gold with a current efficiency of 97–99%. Cyclic voltammograms of both electrodes revealed a linear dependence of j_{pc} vs. $v^{1/2}$ at the studied scan

rates of 1–50 $\text{mV}\cdot\text{s}^{-1}$, which indicates the diffusion limitation of the electrochemical reduction of gold. Based on the Rends-Ševčik equation, the diffusion coefficient of Au^{3+} ions was calculated. Diffusion coefficient of Au^{3+} ions for the concentration of 100 $\text{mg}\cdot\text{L}^{-1}$ on gold and carbon electrodes is determined by the CV method and the values of the coefficient are $1.6\cdot 10^{-5} \text{ cm}^2\cdot\text{s}^{-1}$ and $56.0 \text{ cm}^2\cdot\text{s}^{-1}\cdot\text{g}^{-1}$, respectively. It was also revealed that electroreduction of gold on an activated carbon electrode comes with a high limiting cathode current compared to a gold electrode which is caused by a high specific surface area of the material. When $i = 0$, the system measured at a constant open circuit potential of about +420 mV vs. Ag/AgCl.

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