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SYNTHESIS AND CATALYTIC PROPERTIES OF GOLD NANOPARTICLES FORMED IN THE PRESENCE OF DNA

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Gold nanoparticles (Au NPs) are widely used in biology and biomedicine as optical [illegible] and in catalysis [1]. Their physical and chemical properties are strongly size-dependent [2]. There are many approaches to synthesize Au NPs vie reduction of $HAuCl_4$ by glucose, sodium citrate, ascorbic acid, sodium boron hydride, and other reducing agents [3]. Recently it has been shown that guanine can reduce $HAuCl_4$ with the formation of particles with mean size about 6 nm [4]. The aim was to investigate the ability of DNA macromolecules to reduce Au(III) in the solution and to study the size distribution as well as catalytic properties of thus formed Au NPs. Reduction of 4-nitrophenol by sodium boron hydride was chosen as the model catalytic reaction.

The interaction of $HAuCl_4$ with DNA was studied with different ratios of DNA and Au in the solution. Upon addition of $HAuCl_4$ into DNA solution, the DNA-Au complex was formed. The nanoparticles were found only after 48 hours and if ratio of DNA/Au in the solution below 1. TEM image of Au NPs and their size distribution are shown in Fig.1. It was found that the average size of Au NPs was 0.9 nm, is smaller than of those obtained in presence of glucose (1 nm), guanine (6 nm), $NaBH_4$ (4 nm), or ascorbic acid (16 nm) [3]. Based on this result, we can suggest that it is possible to obtain Au NPs in presence of DNA. Reduction of 4-nitrophenol catalyzed by Au NPs was monitored by measuring the mixture absorbance at λ 400 nm (the electronic absorption spectra are shown in Fig.2.) It is clearly seen that without AuNPs no changes in the spectra were observed, indicating no reaction even at 1000-fold excess $NaBH_4$. However, the addition of AuNPs induced rapid color change. The plot of the natural log of the absorbance at 400 nm versus time is shown in Fig. 3. Thus, mixing DNA solutions with $HAuCl_4$ resulted in the Au-DNA complex and Au NPs formation, the reduction of 4-nitrophenol to 4-aminophenol by sodium boron hydride was catalyzed by Au nanoparticles obtained in the presence of DNA. The rate constant of 4-nitrophenol reduction catalyzed by Au NPs prepared in the presence of DNA ($9.62*10^{-2}$ s^{-1}) was an order of magnitude higher in comparison with those formed in the presence of ascorbic acid ($7.07*10^{-3}$ s^{-1}) or glucose ($6.54*10^{-3}$ s^{-1}). The difference in the catalytic properties was likely due to the difference in the particles size.

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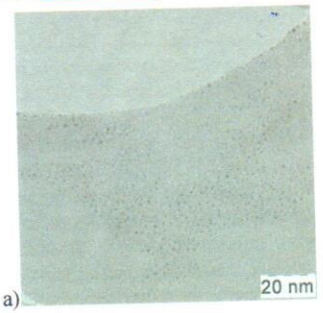

a)

b)

Fig. 1. a) TEM image of gold nanoparticles synthesized by reduction of $HAuCl_4$ with DNA. b) Size distribution of the formed nanoparticles (200 particles).

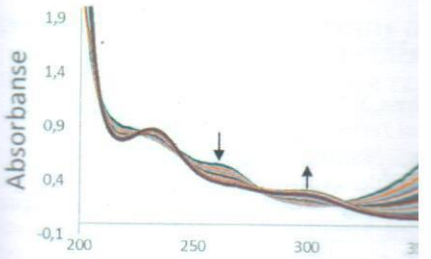

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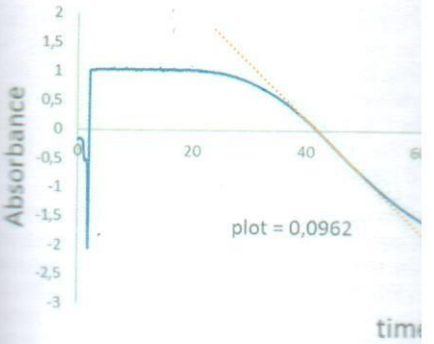
Fig.2. The electronic absorption spectra of 4-nitrop



time

Fig. 3. Natural log of the absorban

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