PHYSICAL CHEMISTRY 2014

12th International Conference
on Fundamental and Applied Aspects of
Physical Chemistry

The Conference is dedicated to the
25. Anniversary of the Society of Physical Chemists of Serbia

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SYNTHESIS OF GOLD NANOPARTICLES USING ALDEHYDE FUNCTIONALIZED LEVAN AS REDUCING AGENT

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ABSTRACT

In this work, gold nanoparticles (AuNPs) were synthesized in aqueous solution by aldehyde functionalized microbial polysaccharide levan as a reducing agent. Resulting nanoparticles were characterized by UV-Vis spectroscopy and by particle size analysis.

INTRODUCTION

The field of nanotechnology is in significant development as a result of wide application in different areas. The unique properties of nanoparticles are directly related to their wide use. In the last years, the application of polysaccharides in preparing nanoparticles greatly increased due to high content of hydroxyl groups in the glycan molecule that represents excellent matrix for providing the stability of formed nanoparticles in solution [1,2]. In this context, levan has an interesting potential, because it represents the relatively unexplored member in this area. This microbial polysaccharide (Fig.1) generally consists of β-(2,6)-fructose residues and a one D-glucose residue at the nonreducing end of the chain. Branching that occurs through β-(2,1)-linkages is often short and sometimes consisting of a single fructose residue. Levans have the great potential for application in food, pharmaceutical, medical, cosmetic and chemical industries, due to high solubility in water, non-toxicity and biocompatibility [3]. Gold nanoparticles (size range 1-100 nm) have physical and chemical properties different from the same material in bulk form, preferably because of large surface/volume ratio. They exhibit, in comparison with other metals, unique optical, electronic and bioactivity properties [4].

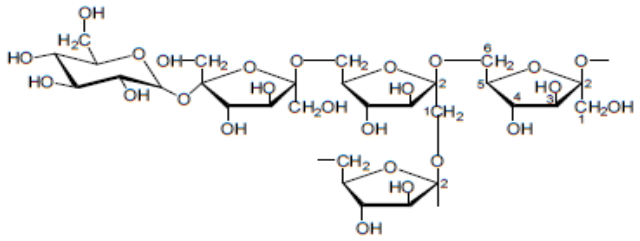

Figure 1. Structure of levan

This paper reports the formation of gold nanoparticles (AuNPs) in aqueous solution of partially oxidized levan with aim of obtaining potentially applicable nanoparticles in various fields.

EXPERIMENTAL

Aldehyde-functionalized levan was obtained in reaction with periodate salts in aqueous solution at room temperature for 24 h. The aqueous solution of 10 mM $HAuCl_4$ was mixed with aqueous solution of 0.062 mM partially oxidized levan, that has been previously purified by dialysis and lyophilization. This resulted in the almost immediate appearance of pale purple color which has became dark purple by heating at 100 ^{o}C for one minute. The obtained products were characterized by UV-Vis spectroscopy (GBC Cintra 40 spectrophotometer) and by photon correlation spectroscopy (PCS), instrument Zetasizer NS with 633 nm He-Ne laser (Malvern).

RESULTS AND DISCUSSION

The aqueous gold ions Au^{3+} were reduced to metallic gold Au^{o} using aldehyde functionalized polysaccharide levan. Due to the high surface energy and extreme reactivity of AuNPs, the polysaccharide matrix of partially oxidized levan was stabilizing agent that prevented aggregation of obtained particles [5-7]. Levan contains different types of vicinal diol groups that can be subjected to periodate oxidation resulting in different types of dialdehyde structures.

The obtained particles were firstly characterized by UV-Vis data. UV-Vis spectrum of formed solution showed a strong absorption maximum at 520 nm (Fig. 2.) characteristic for AuNPs, due to its surface plasmon resonance. Their formation was confirmed visually too, based on the change in color of the solution, from pale yellow at the start of the reaction to dark purple.

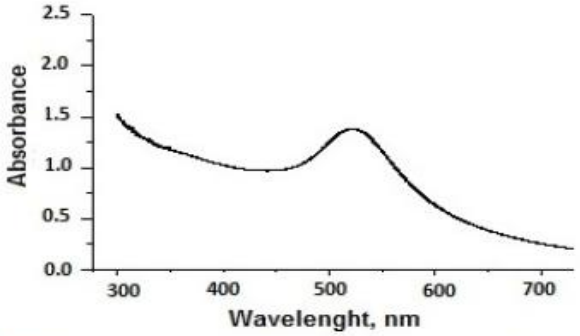

Figure 2. UV-Vis spectrum of gold particles synthesized by aldehyde functionalized levan

The size distribution of synthesized gold particles, based on backscattered light intensity, evidenced their nanometric size, Fig. 3. The strong Gaussian peak in the range 10-100 nm indicated that the particles exhibited mainly monomodal distribution (mean diameter of 95.5% particles 34.28 nm). A small amount (4.5%) of larger sized population (3010 nm) also present, pointed to some particles aggregation.

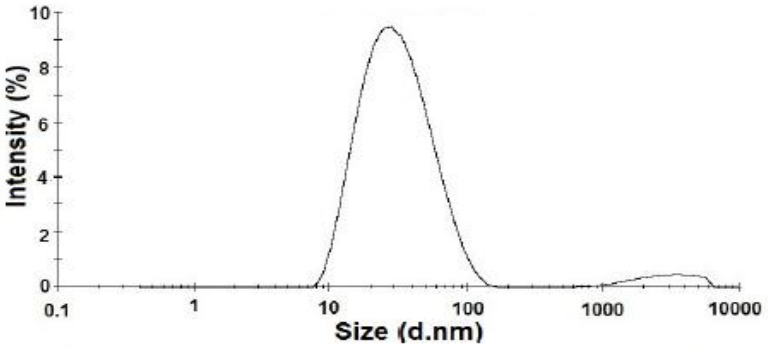

Figure 3. Size distribution of gold particles measured by PCS

CONCLUSION

In this work, a new route for the synthesis of gold nanoparticles in the aqueous medium using the aldehyde functionalized polysaccharide levan as a reducing agent was shown. The synthesis of AuNPs was confirmed by UV-Vis spectroscopy and by particle size analysis. Formation of thus obtained nanoparticles suggests that polyaldehyde levan is reducing agent as

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ACKNOWLEDGEMENT

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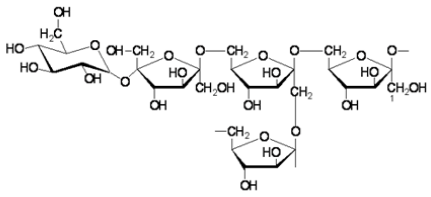

Figure 1. Structure of levan

Aim

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Experimental

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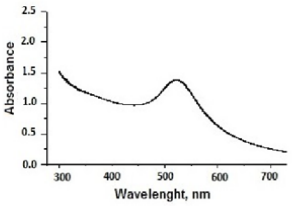
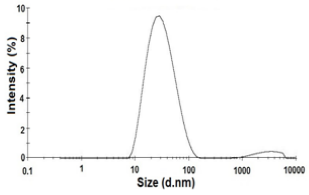


Figure 2. UV-Vis spectrum of gold particles synthesized by aldehyde functionalized levan



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