The bactericidal effect of silver nanoparticles

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Nanotechnology is expected to open new avenues to fight and prevent diseases using atomic scale tailoring of materials. Rapid development of bio-nanotechnology and material research leads to a new way in combating bacteria and searching specific properties of nanomaterials. Presently, the increased resistance of bacteria against strong antibiotics offers to nanomaterial research a chance to help alleviating this problem.

The present work studies the bactericidal effect of silver nanoparticles in the range of 7-50 nm on Gram-negative bacteria and Gram-positive bacteria. The colloid silver nanoparticles was prepared by the modified Türkewitsch´s method. This colloid particles has the specific properties which have bactericidal effect.

Prepared silver nanoparticles were characterized by localized surface plasmon resonance (Fig. 1) and by TEM microscope (Fig. 2). Cells were grown in Lysogeny Broth (LB) medium and plated on Luria-agar plates (LA; LB with addition of 15% of agar). The overnight cultures were diluted in LB such that the final concentration of cells was (1-3) . 10^7 cells/mL and used for antimicrobial assays. After overnight cultivation a number of colonies representing the number of living (surviving) cells was calculated. The bactericidal efficacy of Ag nanoparticles on bacteria was estimated according to the formula I.

Formula I:

$$\text{bactericidal efficacy (\%)} = \frac{\text{alive number in reference group} - \text{alive number in experiment group}}{\text{alive number in reference group}} \times 100\%$$

Keywords: silver nanoparticles, bactericidal

References:

[1] J. Kimling, M. Maier, B. Okenve, V. Kotaidis, H. Ballot, and A. Plech: Turkevich Method for Gold Nanoparticle Synthesis Revisited, J. Phys. Chem. B, 110 (32), 15700 -15707

[2] Appleyard, R.K., Segregation of new lysogenic types during growth of doubly lysogenic strains derived from Escherichia coli K-12. Genetics, 1954. 39: p. 440-452.

[3] Luria, S.E., Host-induced modifications of viruses. Cold Spring Harb Symp Quant Biol, 1953. 18: p. 237-44.

[4] Huang, L., et al., Controllable preparation of Nano-MgO and investigation of its bactericidal properties, J. Inorg. Biochem, 2005, 99(5):p. 986-93

[5] A. Fojtik, P. Mulvaney, T. Linnert, M. Giersig and A. Henglein, Formation and Reduction of Semiconductor-Like Aggregates of Silver-Carboxy-Alkane-Thiolates in Aqueous Solutions, Ber. Bunsenges. Phys. Chem. 95, 1991

[6] A. Henglein, T. Linnert, P. Mulvaney, Reduction of Ag+ in Aqueous Polyanion Solution: Some Properties and Reactions of Long-Lived Oligomeric Silver Clusters and Metallic Silver Particles, Ber. Bunsenges. Phys. Chem. 94, 1990

Figures:

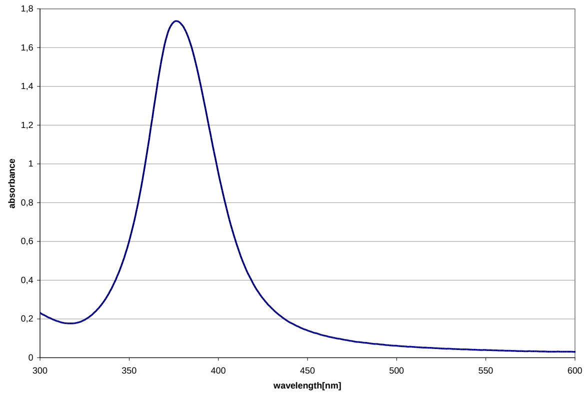

Fig. 1: Absorption spectra of silver nanoparticles

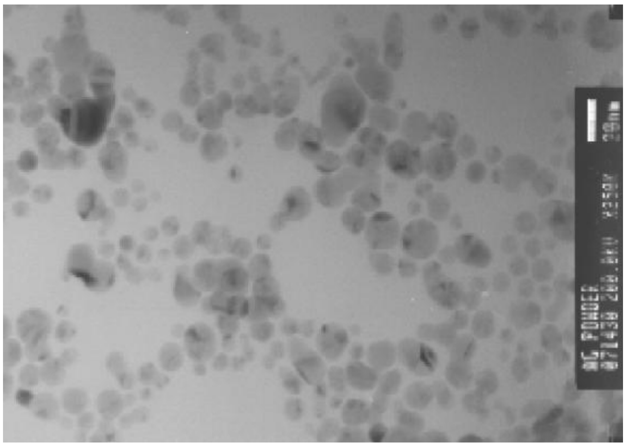

Fig. 2: TEM characterization of silver nanoparticles