

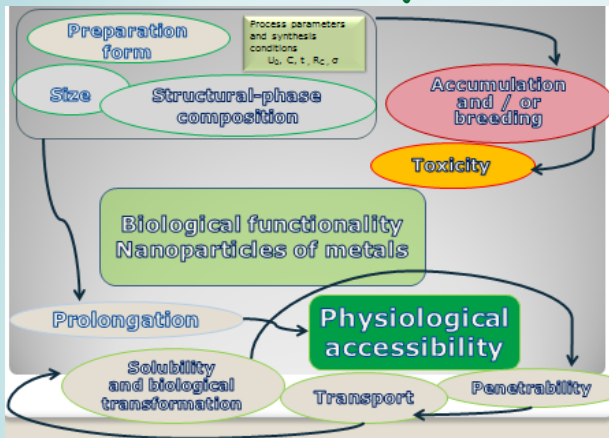
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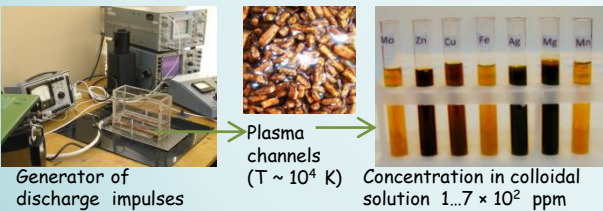
Abstract

This work deals with investigation of peculiarities of metal nanoparticles generation by underwater discharges and their testing in several biological applications. The aim of our contribution is the studies of kinetics of colloidal particle forming. Spectroscopic investigation were used to access the electron temperature in electric spark discharges. Calculations of radiative properties (i.e. net emission coefficients) for water – copper mixtures were also carried out to realize an energy balance of the process (these data will be also used in a future step for the modelling of the process). Relaxation of input energy and the most important physical mechanisms were analysed. Analysis of results of microbiological testing of obtained substances indicates that nanoparticles are effective fungicides for *Penicillium* sp. and *Alternaria alternata*. Thus, bactericidal properties of proposed nanoparticles can be used in medical and biological applications.

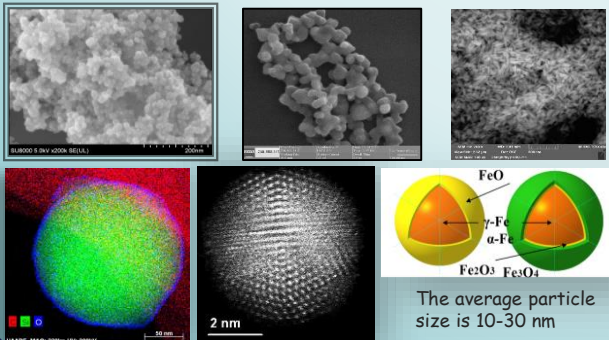
Biological functionality and preconditions for the use of nanoscale objects



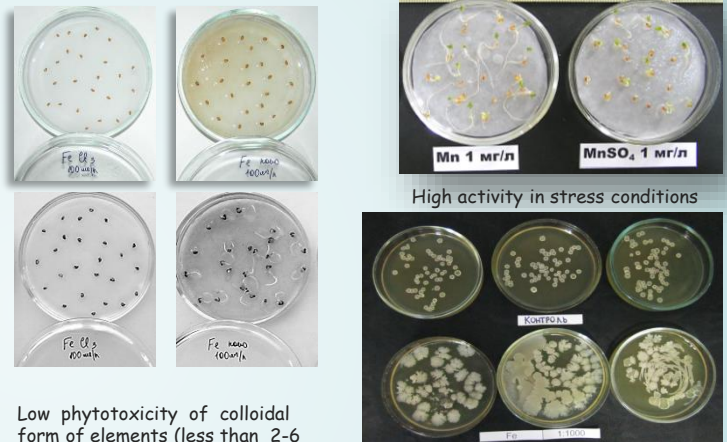
Synthesis of metal nanoparticles by underwater discharges



General structure of nanoparticles



Comparative phytotoxicity of various forms of metals



Low phytotoxicity of colloidal form of elements (less than 2-6 times in comparison with metal salts

Influence of iron nanoparticles on cultural properties of colonies *B. Subtilis* 413

Biocidal and physiological properties of metal colloids



Definition of toxicity threshold by bees

Conclusions

1. It was experimentally established that the biological activity of nanoparticles slows down with the increase of the size of nanoparticles or aggregates formation, as well as with the increase of oxidation level of the metal phase (formation of oxides CuO ; Fe_2O_3 ; MnO_2) and the amount of oxide phase on the surface of particles. Laboratory and vegetation studies of the test cultures showed that colloidal form of metals is effective if the mineral nutrition of plants in the conditions of carbonate and salt stress was disturbed, when the ionic form of mineral nutrition is physiologically inaccessible.
2. A prolonged biological effect can be achieved due to the gradual dissolution of the colloidal particles of metal in the cell space. Additionally, at the same concentrations as compared with metal salts, metal colloids have 1,3-6 times less phytotoxic effect on the plants when the range of concentrations is 1-100 mg l^{-1} .
3. The effectiveness of the improvement of phytosanitary state of agrocenosis by using fungicidal and bactericidal properties of metals such as copper, silver, zinc, has been proven by field tests. This allowed to decrease the plant incidence of Septoria blight in 2.5-3 times when growing winter wheat in the field.