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SYNTHESIS AND PRECISE DEPOSITION OF GOLD NANOPARTICLES USING ELECTROSPRAY TECHNIQUE

The growth of interests in preparation and deposition of nanoparticles (especially gold nanoparticles - AuNPs) causes their application in a modern industry and manufacturing. Innovative application areas require nanomaterials with well-defined shape, size and size distribution. Moreover, important is the concentration, stability and shelf-time of colloidal nanoparticles. By the selection of preparation method it is possible to obtain nanoparticles with desired characteristic. In the applied science the incorporation method of nanoparticles is also crucial. It is extremely important in the area of modern electronics construction.

Hybrid memory structures, utilizing a combination of organic/inorganic materials, are promising candidates for electronic devices in modern information storage technologies such as non-volatile memory elements. Different approaches of NPs incorporation into hybrid electronic devices could be applied according to specific requirements of the final structure (Fig. 1).

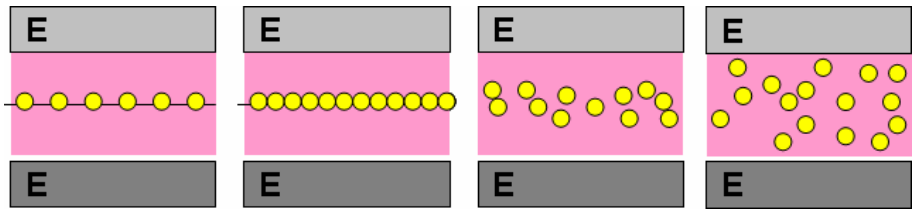

Fig. 1. Schematic structure of hybrid memory elements.

The main dissertation subject is the study on new synthesis method of highly monodisperse gold nanoparticles in organic media and elaboration of nanoparticles deposition technique onto different substrates including memory devices.

In order to obtain single layer of nanoparticles method based on electrospraying of liquid was elaborated. To achieve well distributed gold nanoparticles in polymer matrix the usage of organic colloid was proposed. In the doctoral thesis the optimize method for the

preparation of monodispersed nanoparticles in organic media is presented. Organic colloids are suitable for inks preparation. Organic inks witch AuNPs are used for spin-coated or printed layer in modern electronic fabrication. In the dissertation, a procedure of synthesis of highly monodisperse AuNPs, directly in non-polar solvents via electrospray-assisted chemical reduction method was presented. The presented method consists of two steps: first, the generation of precursor solution aerosol under the electric field, and second, the chemical reduction of dispersed gold ions with different carbinolamine in the reactive bath. Spherical AuNPs with defined size and very narrow size distribution are obtained in specific organic solvent and can be directly used in hybrid organic-inorganic materials, *e.g.*, in polymeric thin-film transistors or memory elements.

Second application of the electrospray technique is nanoparticles deposition onto hybrid memory elements. An important feature and advantage of this method is quick solvent evaporation that allows to deposit particles in dry form onto the substrate. By controlling several parameters of electrospraying system e.g. the flow rate, the deposition time, the acceleration voltage, the distance between the sprayer nozzle and the substrate, the operation mode, etc., the coverage of the substrate can be changed in a wide range from few nanoparticles to single layer or multiple layers.

Developed and optimized method, presented in the thesis, could be used in different application areas, not only in the area of modern electronic. Developed synthesis method allows to obtain highly monodisperse gold nanoparticles and electrospray deposition technique is appropriate for deposition of nanoparticles from different colloidal suspension.

The part of experimental work on the application of synthesis and deposition method was carried out under interdisciplinary project: *Hybrid organic/ inorganic memory elements for integration of electronic and photonic circuitry.* The main project task was construction of working memory elements with embedded nanoparticles. During research work final working memory elements with AuNPs were achieved. Prepared electronic devices show proper electric characteristic and switching behavior. Constructed memory elements are promising complement to traditional silicon electronic.