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# SINTEZA NANOČESTICA MAGNETITA U MIKROFLUIDIČKOM SUSTAVU S 2-D HIDRODINAMIČKIM FOKUSIRANJEM

## MAGNETITE NANOPARTICLES SYNTHESIS IN MICROFLUIDIC SYSTEM WITH 2-D HYDRODYNAMIC FOCUSING

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Magnetite nanoparticles due to their remarkable properties are of significant interest in many fields such as medicine, health care, agriculture and environmental remediation [1]. For all applications there is a great need for improved and highly controlled methods for synthesis of magnetite nanoparticles that are capable of yielding particles of uniform size, geometry and stoichiometry. Numerous batch methods for magnetite synthesis have been described from which co-precipitation is the most common one but process control is made difficult because of the stochastic nature of reactant mixing [1,2]. Therefore, a co-precipitation method in microfluidic reactor was used due to improved control they provide over reaction conditions relative to batch co-precipitation method. Microfluidic reactors offer an attractive route to continuous magnetite production due to high levels of control they provide over key reaction parameters such as reagent concentration gradient and reaction time [3]. Reactor with geometry which allowed 2D hydrodynamic focusing (no focusing in vertical direction) was used in which mixing of reagents can be precisely controlled with rate of continuous streams through microscale channels where nucleation and growth take place. Main goal was to improve synthesis route for magnetite nanoparticles for obtaining high quality nanoparticles with uniform size. In microfluidic reactor continuous synthesis can be obtained which increases the production rate and that is one of main goals of industry also the atmospheric influence is reduced which prevents the oxidation thus increase the quality of synthesized nanoparticles.

*Keywords:* magnetite, nanoparticles, microfluidic, hydrodynamic focusing, co-precipitation

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# TALOŽENJE KALCIJEVA OKSALATA U MODELNIM SUSTAVIMA HIPEROKSALURIJE

## CALCIUM OXALATE PRECIPITATION IN MODEL SYSTEMS MIMICKING HYPEROXALURIA CONDITIONS

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According to the latest epidemiological studies, the prevalence of urolithiasis has been increasing for the past few decades, especially in industrialised countries, possibly due to improved standard of living and modern dietary habits. Urolithiasis is the formation of crystals in the urinary tract and is a specific form of pathological biomineralisation. It is a result of physiochemical mechanisms and involves the processes of nucleation, crystal growth and aggregation. Many factors may contribute to crystallisation and urinary stone formation including pH, ionic strength and the presence or absence of substances that can promote or inhibit the process [1]. Different metabolic disorders, which can be inherited or developed, are considered to be important risk factors and include hyperoxaluria, hypercalciuria, hypocitraturia and changes in acidity of the urine. Hyperoxaluria is associated with oxalate urinary tract stones and oxalate crystal deposition in tissue [2].

In this work, systematic research of spontaneous calcium oxalate precipitation in three systems with different levels of complexity (simple, NaCl and artificial urine system) and two different initial pHs (pH<sub>i</sub> = 5.0 and 9.0) was conducted. In all investigated systems which simulate the conditions of hyperoxaluria, a dominant precipitation of calcium oxalate monohydrate (COM) was noted, except in the artificial urine system at pH<sub>i</sub> = 9.0, where precipitation of a mixture of calcium oxalate monohydrate (COM) and calcium oxalate dihydrate (COD) occurred. The most pronounced difference was observed in COM morphology. In the simple system crystals precipitated in dendritic form, in the NaCl system they took a dendritic form with more or less irregular shaped crystals, while in artificial urine aggregated and prismatic hexagonal COM crystals precipitated.

*Keywords:* calcium oxalate monohydrate, hyperoxaluria, kidney stones