Nanocomposites and nanomaterials

Advanced materials engineering within a software-defined nanotechnology: the concept and implementation

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Recent advancements in the field of advanced materials indicate the accelerating evolution of the materials fabrication methods toward a dynamic and controllable routes and approaches. The number of steps required to obtain desired material, as well as their complexity and the accuracy requirements for measurements raised significantly. Hence, the development of automated laboratory equipment with programmable reaction cells that combine a wide range of capabilities to control the target system with advanced *in situ* measurement options will mark a transition from a traditional manual experimental toward a software-defined nanotechnology. In present report, the implementation of such approach for the controllable formation of hybrid nanocomposites that combine conducting polymers based on aniline derivates with embedded silver nanoparticles is presented [1].

Open-source hardware based on 32 bit ARM Cortex-M4 MCU running at 72 MHz has been used as a base for implementing control module, that may be further upgraded to 180 MHz version for a high-precision applications. In current state, the reaction controller allows implementation of a frequency- and delay-based electrochemical control using high-precision polarization cycles, as well as optically coupled methods. *In situ* temperature and pH measurement capabilities, combined with thermostat and steering control will be added on a later stages of development owing to a modular architecture and open software platform that allows further expansion of the functionality.

Application of programmable reaction cells allows one to obtain nanostructured materials in a stable and reproducible way that is crucial parameter for both laboratory research and material fabrication.

1. *Vyshnevska Yu.P, Brazhnyk I.V* The Electrochromic Feedback Methods for Obtaining Nanoparticles, Nanoalloys and Core-Shell Objects in Quasi-reversible Redox Systems // Springer Book Nanophysics, Nanomaterials, Interface Studies, and Applications.-2017.-P. 397–403 (in press).