Journal of the Serbian Chemical Society
JSCS-info@shd.org.rs • www.shd.org.rs/JSCS
J. Serb. Chem. Soc. 85 (11) S513–S517 (2020) *Supplementary material*

SUPPLEMENTARY MATERIAL TO

From molecules to nanoparticles to functional materials

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J. Serb. Chem. Soc. 85 (11) (2020) 1383–1403

GENERAL EVALUATION OF RESULTS

The research results of the project in the 2011–2019 period were published in one monograph (Nanotechnologies in Preventive and Regenerative Medicine: An Emerging Big Picture", Elsevier, 2018, 590 pages, Editors: V. Uskoković & D. Uskoković), 80 SCI articles cited 1574 times in the same period with the Hirsch index of 23, eight PhD thesis, four patents, eight invited conference proceedings, and one concept for a spin–off commercialization program. Eight articles were published in the journal Colloids and Surfaces B: Biointerfaces, 6 in Materials Science and Engineering C, 3 in Journal of Power Sources, 3 in Ceramics International, and other journals are represented with 2 or less of the published papers. The list of the most cited articles according to SCOPUS database is shown in Table S–I.

TABLE S–I. The most cited publications of the MODENAFUNA project for the period 2011–2019 (as of December 31, 2019)

Ref.	Document	Citations
1	V. Uskoković *et al*., Nanosized hydroxyapatite and other calcium phosphates: Chemistry of formation and application as drug and gene delivery agents, *Journal of Biomedical Materials Research: Part B – Applied Biomaterials* **96** (2011) 152	315
2	J. Petković *et al.*, DNA damage and alterations in expression of DNA damage responsive genes induced by TiO_2 nanoparticles in human hepatoma HepG2 cells, *Nanotoxicology* **5** (2011) 341	133
3	A. Stanković *et al*., Influence of size scale and morphology on antibacterial properties of ZnO powders hydrothemally synthesized using different surface stabilizing agents, *Colloids and Surfaces B: Biointerfaces* 102	91

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Ref.	Document	Citations
	(2013) 21	
4	M. Stevanović *et al.*, Poly(lactide–co–glycolide)/silver nanoparticles: Synthesis, characterization, antimicrobial activity, cytotoxicity assessment and ROS–inducing potential, *Polymer* **53** (2012) 2818	48
5	N. Ignjatović *et al.*, Nanoparticles of cobalt–substituted hydroxyapatite in regeneration of mandibular osteoporotic bones, *Journal of Materials Science: Materials in Medicine* **24** (2013) 343	47
6	S. Marković *et al.*, Synthetical bone–like and biological hydroxyapatites: A comparative study of crystal structure and morphology, *Biomedical Materials* **6** (2011) 045005	47
7	M. Lukić *et al.*, Dense fine–grained biphasic calcium phosphate (BCP) bioceramics designed by two–step sintering, *Journal of the European Ceramic Society* **31** (2011) 19	46
8	M. Stevanović *et al.*, Multifunctional PLGA particles containing poly(l–glutamic acid)–capped silver nanoparticles and ascorbic acid with simultaneous antioxidative and prolonged antimicrobial activity, *Acta Biomater.* **10** (2014) 151	45
9	N. Ignjatović *et al.*, Chitosan–PLGA polymer blends as coatings for hydroxyapatite nanoparticles and their effect on antimicrobial properties, osteoconductivity and regeneration of osseous tissues, *Materials Science and Engineering C* **60** (2016) 357	43
10	S. Marković *et al.*, Application of raw peach shell particles for removal of Methylene Blue, *J. Environ. Chem. Eng.* **3** (2015) 716	41

The project was implemented by a research team consisting of one experienced professor, four young scientists and seven young researchers who were admitted to the project just before or during its implementation, and continued to work at the Institute after completing their doctoral dissertations. Significant contribution to the realization of the project was also given by four experienced PhDs from foreign institutions funded not by the project, but through international or bilateral cooperation (Srečo Škapin, Metka Filipič, Vuk Uskoković and Victoria Wu). They made a substantial input to the project, both through advanced experimental methods not accessible or economically feasible to perform in Serbia country and through a significant scientific expertise. The project lasted from January 1, 2011 to December 31, 2019 and had a total budget of 1.35 million €, of which 900,000 € was allocated to the researchers' salaries, ≈350,000 € for major equipment (Setaram Instrumentation: TMA, TGA/DTA/DSC, MS) and 100,000 € for the minor equipment and laboratory items and supplies.

A comparative analysis of the factors of influence was carried out for all the national projects funded by the Ministry of Education, Science and Technology in the field of integral and interdisciplinary research (III) between 2011 and 2019. The factor of influence is defined here as the ratio of the number of citations of the principal investigator and the number of publications authored by

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the project team in the specified period. The project output measured by the number of publications corresponds to the number of publications listed in the nine–year period (2011–2019) in the SCOPUS database for the given principal investigator. Natural science projects (physics and chemistry, OI) in the field of nanoscience & nanotechnologies were added to this list (Fig. S–1.). It is observed that this ratio is the second highest for the MODENAFUNA III 45004 project. Similar applies to the Hirsch index (H), which is the highest (23) for the principal investigator of the Project III 45004 (Fig. S–2.).

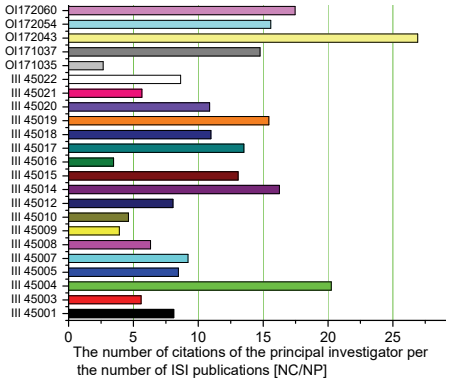

Fig. S–1. The number of citations of the principal investigator per number of ISI publications (NC/NP) authored by the project team in the specified period (2011–2019).

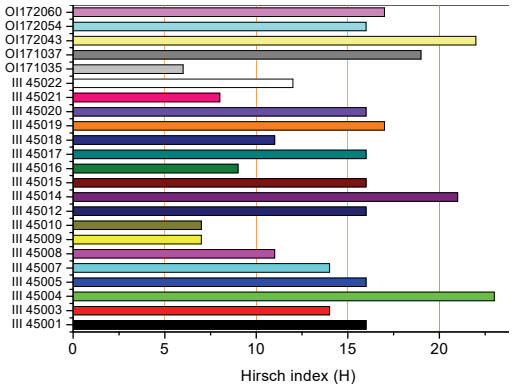

Fig. S–2. The Hirsch index (H) of the principal investigator authored by the project team in the specified period (2011–2019).

Regarding the papers with an international collaboration component, most of them, 42, were published jointly with authors from Slovenia. Twenty two papers were published jointly with the authors from the USA, 2 with the authors from the Republic of Korea, 2 with authors from Russia, and 1 paper with the authors from the UK, Norway, Australia, Poland and Germany each.

Eight PhD theses were successfully defended in the same period: two by Marija Vukomanović, one at Belgrade University[11] and one at Jožef Stefan Institute, Ljubljana, Slovenia[12] where she remained to work after her dissertation, and one by Zoran Stojanović,[13] Ana Stanković,[14] Miodrag Lukić,[15] Ljiljana Veselinović,[16] Miloš Milović,[17] Maja Kuzmanović[18] and Nenad Filipović,[19] all of whom stayed to work at the Institute after their doctorates. Experience from this project has validated the principle obeyed by the world's most prestigious research institutes, which is that the most successful scientists should be retained, the less successful ones transferred to institutes doing applied research, and the new and young talented researchers allowed to take their place. The retention of the graduated researchers engaged in this project serves as a testimony of the

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educational success of the project leaders and their ability to recruit and train a number of prospective researchers of strategic importance for the country's technological and economic development.

The project accomplishments contributed to the improvement of the ranking of the Institute, as deducible from the increase of its H–index from <25 on December 31, 2010 to 48 on December 31, 2019.

Invited lectures were held in the USA, Taiwan, Korea, Italy, Austria, Poland, Switzerland and Croatia. Eighteen international conferences were organized, nine for the leading researchers in the field of materials science and engineering from around the world (YUCOMAT 2011–2019) and nine for young researchers (YRC 2011–2019).

The project management team was especially attentive to the integration of research, education and innovation, seeking to integrate academic and innovative research. Within this goal, the priority was to protect the achieved innovations as patents. Four patent applications[20–23] were registered at the national patent office: Micro and nano spheres of biodegradable polymers with ascorbic acid[20] or silver,[21] Lithium iron phosphate and nano carbon composite,[22] and High density nano bioceramic based on calcium phosphate.[23]

Based on the acquired new knowledge and established new methods for the creation of nano–objects suitable for application in reconstructive medicine, the concept of BORN (Bone Regenerative Nano Materials) spin–off program was formed. Technical documentation for the technological production of small series of calcium phosphate based nanoparticulate materials suitable for bone tissue engineering was prepared. Within the BORN program, technologies for the production of a new generation of multifunctional nano vitamin or antibiotic release systems suitable for bone replacement were introduced. The implementation of the BORN program is being actively discussed with national and international industry partners.

Overall, a number of national projects on nanotechnologies for the period 2011 – 2019 have achieved significant results. The professionals who supervised these projects achieved a large number of publications in this period, reaching an average H–value of over 15. Half of them were cited more than 1000 times, which is very high for the scientific climate in Serbia, with MODENAFUNA III 45004 being classified as the highest–ranked project.

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