

## *Institute of Technical Sciences of SASA – Annual Report 2008*

The work of the Institute of Technical Sciences of the Serbian Academy of Sciences and Arts is governed by the Management Board, appointed by the Presidency of SASA (the Management Board has seven members: four academicians and three senior researchers working at the Institute), and an executive director. The appointment of new members of the Management Board was due in early 2006. However, issues related to the status of the SASA Institutes, and particularly those related to their management bodies, were suspended by Decision No. 365/1 of the SASA Presidency, as of April 19, 2005, until the enactment of the new Law on the Serbian Academy of Sciences and Arts. A new Management Board and Scientific Council will be appointed after the Law is adopted, which is expected in near future. Newly established bodies will then undertake the drafting of the Statutes and other regulatory acts in compliance with the new Law on SASA and the Law on Scientific Research. In accordance with the decision of the Executive Board of the Presidency of SASA, Academician Pantelija Nikolić was appointed to the position of a Management Board Member, previously occupied by Academician Petar Miljanić. The position of the Director of the Institute has been occupied by Prof. Dr. Dragan Uskoković since 2001.

The Institute has 32 employees, 25 of whom are involved in research projects funded by the Ministry of Science and Technological Development of the Republic of Serbia; 15 of them have a Dr. Sci. degree, four a MSc degree (non-Bologna compliant), whereas two have a Bologna-compliant Master's degree. Five academicians have been leading research programmes at the Institute over a long period of time. During 2008, four researchers left the Institute and a new junior researcher was employed; four researchers defended their doctoral theses and two acquired a MSc degree (non-Bologna compliant). Four employees were promoted to higher research titles. Two doctoral and three magisterial theses are in progress.

Six projects carried out at the Institute are funded by the Ministry of Science and Technological Development within the Fundamental Research Programme. Two of them, involving a number of research institutions in Serbia and two-thirds of Institute's research staff, are coordinated by the Institute of Technical Sciences of SASA.

1. Project Grant No. 142006: "Synthesis of functional materials with a controlled structure on molecular and nano levels"; Project Leader: Prof. Dr. Dragan Uskoković;
2. Project Grant No. 14011: "The study of interdependence within the 'synthesis-structure-properties' triad for functional materials"; Project Leader: Academician Momčilo M. Ristić.

During the first three months of 2008, the Ministry of Science of the Republic of Serbia also funded four technological development projects and one commissioned research from the previous project cycle. Since April 2008, it provides funding for five projects within the Technological Development Programme (Project Cycle 2008-2010) in which the Institute of Technical Sciences of SASA appears either as the research coordinator or merely as a participant. Generally speaking, nine-tenths of the funds provided by the Ministry of Science and Technological Development are allocated to the fundamental research projects, whereas the share of the technological development projects is one-tenth of the total budget.

New categorization of researchers involved in the fundamental research projects and project evaluation and ranking were carried out in early 2008 in accordance with the results achieved in 2006 and 2007. Funds for supplies and material expenditures were allocated depending on the ranking.

Apart from the above-mentioned, two projects coordinated by academicians have been funded through the Scientific Research Fund of SASA: F 131 – coordinated by Academician Nikola Hajdin, and F 153, coordinated by Academician Miomir Vukobratović.

Scientific and technological results of the mentioned projects include 40 SCI publications (either published or accepted for publication during 2008), a patent application registered by the European Patent Organization, two technical documentation projects, commissioned expert's studies, the City of Belgrade Prize for achievements in the fields of natural and technical sciences in 2007, an invention award, a best doctoral thesis award, a best magisterial thesis award, and a best conference poster award.

We would particularly like to draw attention to the following publications:

1. Grgur, B.N., Gvozdenovic, M.M., Stevanovic, J., Jugovic, B.Z. & Marinovic, M.V. 2008, "Polypyrrole as possible electrode materials for the aqueous based rechargeable zinc batteries", *Electrochimica Acta*, Vol. 53, No. 14, pp. 4627-4632
2. Grgur, B.N., Ristic, V., Gvozdenovic, M.M., Maksimovic, M.D. & Jugovic, B.Z. (2008), "Polyaniline as possible anode materials for the lead acid batteries", *Journal of Power Sources*, Vol. 181, No.1, pp. 635-640
3. Ivetić, T., Nikolić, M.V., Paraskevopoulos, K.M, Pavlidou, E., Zorba, T.T, Nikolić, P.M. & Ristić, M.M. 2008, "Combined FTIR and SEM-EDS Study of Bi<sub>2</sub>O<sub>3</sub> Doped ZnO-SnO<sub>2</sub> Ceramics", *Journal of Microscopy*, vol. 232, issue 3, pp. 498-503
4. Jevtić, M. Mitrić, M., Škapin, S., Jančar, B., Ignjatović, N. & Uskoković, D. 2008, "Crystal structure of hydroxyapatite nano-rods synthesized by sonochemical homogenous precipitation", *Crystal Growth and Design*, vol. 8, no. 7, 2217-2222
5. Jovalekić, C., Zdujić, M., Poleti, D., Karanović, L. & Mitrić, M. 2008, "Structural and electrical properties of the 2Bi<sub>2</sub>O<sub>3</sub>·3ZrO<sub>2</sub> system", *Journal of Solid State Chemistry*, vol. 181, no. 6, pp. 1321-1329
6. Jugovic, D., Mitric, M., Cvjeticanin, N., Jancar, B., Mentus, S. & Uskokovic, D. 2008, "Synthesis and characterization of LiFePO<sub>4</sub>/C composite obtained by sonochemical method", *Solid State Ionics*, Vol 179, pp. 415-419
7. Kusigerski, V., Marković, D., Spasojević, V., Cvjetićanin, N., Mitrić, M., Jugović, D. & Uskoković, D. 2008, "Ground-state magnetism of chromium-substituted LiMn<sub>2</sub>O<sub>4</sub> spinel", *Journal of Magnetism and Magnetic Materials*, vol. 320, no. 6, pp. 943-949
8. Marinkovic, B.A., Mancic, L., Jardim, P.M., Milosevic O. & Rizzo, F. (2008) Hydrothermal synthesis of Na<sub>x</sub>Fe<sub>x</sub>Ti<sub>2-x</sub>O<sub>4</sub> from natural ilmenite sand: A CaFe<sub>2</sub>O<sub>4</sub> structure type compound, *Solid State Communications*, Vol. 145, No. 7-8, pp. 346-350
9. Marković, S., Mitrić, M., Starcević, G. & Uskoković, D. 2008, "Ultrasonic de-agglomeration of barium titanate powder", *Ultrasonics Sonochemistry*, vol. 15, no. 1, pp. 16-20
10. Martin, M.I., Rabanal, M.E., Gomez, L.S., Torralba, J.M. & Milosevic, O. 2008, "Microstructural and morphological analysis of nanostructured alumina particles synthesized at low temperature via aerosol route", *Journal of the European Ceramic Society*, vol. 28, issue 13, pp. 2487-2494
11. Nikolić, M.V., Obradović, N., Paraskevopoulos, K., Zorba, T.T., Savić, S.M. & Ristić, M.M. 2008, "Far infrared reflectance of sintered Zn<sub>2</sub>TiO<sub>4</sub>", *Journal of Materials Science*, vol. 43, no. 16, pp. 5564-5568
12. Nikolić, M.V., Satoh, K., Ivetić, T., Paraskevopoulos, K.M., Zorba, T.T., Blagojević, V., Mančić, L., & Nikolić, P.M. 2008, "Infrared reflection spectroscopy of Zn<sub>2</sub>SnO<sub>4</sub> thin films deposited on silica substrate by radio frequency magnetron sputtering", *Thin Solid Films*, vol. 516, no. 18, pp. 6293-6299
13. Nikolic, P.M., Lukovic, D., Vujatovic, S.S., Paraskevopoulos, K.M., Nikolic, M.V., Blagojevic, V., Zorba, T.T., Stamenovic, B. & Koenig, W. 2008, "Far infrared reflectivity spectra of lead-telluride doped with Ytterbium", *Journal of Alloys and Compounds*, vol. 466, no. 1-2, pp. 319-322
14. Petrović, S., Terlecki-Baričević, A., Karanović, L., Kirilov-Stefanov, P., Zdujić, M., Dondur, V., Paneva, D., Mitov, I. & Rakić V. 2008, "LaMO<sub>3</sub> (M = Mg, Ti, Fe) perovskite

type oxides: Preparation, characterization and catalytic properties in methane deep oxidation", *Applied Catalysis B: Environmental*, vol. 79, no. 2, pp. 186-198

15. Stevanović, M.M., Jordović, B. & Uskoković, D.P. 2008, "Morphological changes of poly(DI-lactide-co-glycolide) nano-particles containing ascorbic acid during in vitro degradation process", *Journal of Microscopy*, vol. 232, issue 3, pp. 511-516

If we were to single out the results we consider particularly important, the list would include: the progress made in the field of biomedical materials science and engineering, materialized in a large number of publications and innovations; the City of Belgrade Prize for achievements in the fields of natural and technical sciences; the introduction of a new method for determining particle size and size distribution using *Mastersizer 2000* laser diffraction particle size analyzer, bought with funds provided within the National Investment Plan (c. 100,000 EUR); four doctoral and two magisterial theses; 32 papers published in the 2008 issues and 15 papers either already published or accepted for publication in the 2009 issues; the work of the Commission of the Expert Council for the construction of the bridge over Ada Ciganlija, headed by Academician Nikola Hajdin, and the Expert Council for the construction of the first line within the Belgrade underground railroad network, headed by Academician Vukan Vučić; significant achievements in the sintering and microstructure development of ZnO-SnO<sub>2</sub> and ZnO-TiO<sub>2</sub> systems, which resulted in two doctoral theses and a number of papers published in international journals; vivid cooperation with national and international research institutions concerning the synthesis and detailed structural characterization of nanophase functional 1D and 3D materials obtained by reactions in aerosol, i.e. by hydrothermal synthesis, resulting in four papers published in journals indexed by Thomson Scientific, seven international conference presentations, one patent, two magisterial theses: one to be defended at the University of Belgrade in early 2009 and one prepared in Brazil, and also one doctoral thesis defended in Madrid, Spain, in December 2008.

Vivid international and national cooperation plays a very important role in the Institute's activities. A particularly fruitful formal or informal cooperation has been established with research institutions from the USA, European Union, Russia, Ukraine, Slovenia and other countries. The greatest part of research programmes carried out at the Institute is implemented within the Sixth and Seventh Framework Programmes of the European Union.

Prof. Dr. Dragan Uskoković has been involved in the cooperation with colleagues from the Institute "Jožef Stefan" in Ljubljana and other research institutions in Slovenia. Bilateral cooperation programme "Designing functional materials on molecular and nano levels" for 2008–2009 has been officially accepted and its implementation has begun. Several publications resulting from this cooperation programme can be found in the above list. The Institute of Technical Sciences of SASA is also involved in the implementation of the INCOMAT Project – "Creating international cooperation teams of excellence in the field of emerging biomaterial surface research", participated by 15 European research institutes and universities. The project was initiated and is coordinated by THÜRINGEN Innovativ GmbH, Innovation Relay Centre Stuttgart–Erfurt–Zürich in Erfurt, Germany. Prof. Dr. Dragan Uskoković and Dr. Nenad Ignjatović are coordinators for the Institute of Technical Sciences of SASA. The INCOMAT Team leader Meeting held in Amsterdam, the Netherlands, in May 2008, was attended by Dr. Nenad Ignjatović. An INCOMAT workshop, gathering project partners' representatives, and Round Table "How to write a successful project proposal" were held as accompanying programmes to the YUCOMAT 2008 Conference. The latter was also eagerly attended by many of the conference participants.

Dr. Olivera Milošević, Dr. Lidija Mančić and Katarina Marinković participated in COST 539 Action (2005–2008): Electroceramics from nanopowders produced by innovative methods (ELENA, Coordinator: Prof. Dr. Biljana Stojanović), <http://www.cost539.cms-bg.net/>. Dr. Olivera Milošević also took part in the implementation of project "Designing of nanoparticle morphology in aerosol synthesis", led by the German Ministry of Education and Research (BMBF), German Research Foundation – DFG (Implementation period: 2006–2008), as an International Expert. As a

follow-up to this project and the cooperation with RWTH Aachen, a project proposal dealing with the synthesis and characterization of nanostructured materials for electronic and optoelectronic applications will be submitted for EU funding. Dr. Olivera Milošević also taught at Carlos III University in Madrid, Spain, as a Visiting Professor. In December 2008, she attended the defence of Luz Gomez's (Carlos III University) doctoral thesis as a member of the Doctoral Thesis Committee.

Between March 24 and June 23, 2008, Dr. Lidija Mančić attended a postgraduate programme at the Pontifical Catholic University of Rio de Janeiro. She worked on the project "TiO<sub>2</sub> based nanotube and nanowire obtaining through hydrothermal treatment of rutile and ilmenite mineral sands", led by Prof. Dr. Fernando Rizzo, and acted as the coordinator of the cooperation under the Cultural, Education and Scientific Agreement between *Faculdades Catolicas* (Brazil) and the Institute of Technical Sciences of SASA. During her visit to Brazil, Dr. Olivera Milošević also had the opportunity to meet Prof. Dr. Rizzo and discuss future cooperation in research projects.

Having been awarded a postgraduate fellowship of the University of Ljubljana and the Jožef Stefan Institute ("Razpis štipendij za mednarodno izmenjavo študentov za 2007/08"), Marija Jevtić and Zoran Stojanović spent three months of the winter term (October 15, 2007 – January 15, 2008) doing experimental work at the Jožef Stefan Institute and the Faculty of Chemistry and Chemical Technology in Ljubljana. The work done in Slovenia was within the scope of their Master's Degree studies and Project 142006.

Dr. Vladimir Zeljković participates in the CIR-CE Innovation Project '*MagnetoPIM – Herstellung von komplexen, weich- und hartmagnetischen Bauteilen mittels PIM*'.

Researchers employed at the Institute are also engaged as editors and peer reviewers in numerous national and international scientific journals.

The majority of researchers employed at the Institute had the opportunity to present their achievements at international and national conferences. The most important international conferences include: the Seventh Brazilian MRS Meeting, Guarujá, Brazil; NANO 2008, Rio de Janeiro, Brazil; Winter School "Women in Nano", Kranjska Gora, Slovenia; MTS-2008, Kiev, Ukraine; Second International Congress on Ceramics, Verona, Italy; Eighth World Biomaterials Congress, Amsterdam, The Netherlands; 35th Annual Meeting & Exposition of the Controlled Release Society New York, USA; YUCOMAT 2008, Herceg Novi, Montenegro, XX Congress of Chemists and Technologists of Macedonia, V Congress of the Metallurgists of Macedonia, FYR Macedonia; ELECTROCERAMICS XI, Manchester, UK; INCOME 2008, Jamshedpur, India; and Physical Chemistry 2008, Belgrade.

Selected papers of YUCOMAT 2007 conference were published in special issues of journals *Materials and Manufacturing Processes* (Taylor and Francis) and *Surface Engineering* (Maney Publishing). Public presentation of both issues was held within the 53<sup>rd</sup> International Belgrade Book Fair in October 2008.

Monographs *Self-organization and sintering*, written by Academician Momčilo M. Ristić and Prof. Dr. Aleksa Marinčić, and *Mathematical Analysis of Sintering Laws of Real Materials*, written by Dr. Vladimir Zeljković, both published in late 2007, were also presented at the 53<sup>rd</sup> International Belgrade Book Fair.

The work on the university textbook on biomaterials, written by a group of outstanding experts from Serbia during 2007 and 2008, is in the technical editing stage. The textbook is to be used at all natural science faculties whose curricula include a course on biomaterials.

In September 2008, the Institute of Technical Sciences of SASA organized the Tenth Annual YUCOMAT Conference. The Conference was held in Herceg Novi, Montenegro, and was attended by about 170 registered participants, who presented about 180 papers. It included three plenary sessions, five symposia and three poster sessions. The accompanying programmes included a Workshop within the EU-funded INCOMAT project and Round Table "How to write a successful

project proposal". The Eleventh YUCOMAT Conference, to be held in 2009, was announced in a number of renowned international conference networks in the USA, Japan, Germany, Italy and Russia. A conference announcement and a report on YUCOMAT 2008 were published by the USA Materials Research Society in the organization's Bulletin and website. Selected papers presented at YUCOMAT 2008 will be published in special issues of journals *Materials and Manufacturing Processes* (Taylor and Francis) and *Acta Physica Polonica A* (Institute of Physics of the Polish Academy of Science). It should be pointed out that the Materials Research Society of Serbia was accepted into membership of the Federation of European Materials Societies. The Federation has 27 members gathering about 20,000 scientists involved in materials science research.

The Seventh Conference of Young Researchers "Advanced Materials Science and Engineering" (December 22–24, 2008), organized by the Materials Research Society of Serbia and the Institute and supported by the Ministry of Science and Technological Development of the Republic of Serbia, was held within the celebration of the Anniversary of the Institute of Technical Sciences of SASA. The abstracts of the accepted presentations (62) were published in the Book of Abstracts. The conference included 58 oral presentations. Selected papers will be published in journals *Hemijska industrija* and *Tehnika – Novi materijali*.

The Anniversary of the Institute of Technical Sciences of SASA was celebrated on December 23, 2008 at the Serbian Academy of Sciences and Arts. Since 1947, when it was founded, the Institute has been involved in science and engineering research projects. Welcoming speeches were given by the President of SASA Nikola Hajdin; the Rector of the University of Belgrade Prof. Dr. Branko Kovačević; Assistant Minister (Ministry of Science and Technological Development of the Republic of Serbia) Tibor Sabo, Vice-Rectors of the University of Belgrade and University of Podgorica Prof. Dr. Aleksandar Sedmak and Prof. Dr. Mira Vukčević, respectively; and the Director of the Institute Prof. Dr. Dragan Uskoković. After the welcoming speeches, five researchers employed at the Institute presented recent results of ongoing research projects. The official ceremony and the cocktail were attended by renowned guests, including State Secretary for Science Prof. Dr. Miloš Nedeljković.

After a long period of inactivity, the Library of the Institute of Technical Sciences of SASA was re-established in 2007, after librarian Milica Ševkušić had been employed. Old library inventories and catalogues have not been preserved and the work of compiling the library database had to be started from the very beginning. Library users mostly include the research staff of the Institute, a half of whom are not on the same premises as the Library. The services they need are usually related to the use of academic databases and specialized reference database and bibliographic tools. In order to make relevant electronic resources easily accessible to all users, a directory of internet resources was made within the Institute's website. It includes writing and citation style guides, journal title abbreviations, links to library directories and academic databases. In late 2008, we launched a series of seminars aimed at keeping researchers informed on new academic services, resources and software tools. An incomplete draft of the Institute's bibliography of papers, covering the period 1975–2008, with links to papers available on the internet, and a list of monographs published since 1950 were also posted to the website of the Institute of Technical Sciences of SASA. The traffic on the Institute's website is being monitored and analyzed using *Google Analytics*. Media representatives and potentially interested scientists from national and international research institutions are kept informed about the activities of the Institute via e-mail, which significantly increases the number of visits. Newly introduced sections (since 2007) on the website include the *News*, *Publications*, *Directory of Internet Resources* and *Poster Gallery*.

Apparatus *Mastersizer 2000* (Malvern Instruments), laser diffraction particle size analyzer, was bought with funds provided by the Ministry of Science and Technological Development. The possibilities it offers fully justify its price – 100,000 EUR. It is available to all interested researchers in Serbia involved in non-commercial or commercial projects upon submission of the application form available on the Institute's website. Laboratory equipment bought during 2008 also includes:

an apparatus for reverse osmosis, vessels and zirconium oxide balls for the planetary ball mill, and additional equipment for *Mastersizer 2000*. Other equipment includes: a laptop computer, a desktop computer, a monitor and a printer, as well as tables for new apparatuses.

Funds provided by the Ministry of Science and Technological Development of the Republic of Serbia cover 87 percent of the Institute's income. Compared to 2007, the average monthly salary of the research staff in 2008 was 36 percent higher (salary increases: March 2008 – 5 percent, October 2008 – 30 percent).

### **Conclusion**

For the Institute of Technical Sciences of SASA, 2008 was another successful year of scientific growth. Four young researchers acquired a Dr. Sci. Degree, whereas two obtained their MSc degree. The Institute now employs 15 researchers with a Dr. Sci. degree, which is a significant progress compared to the situation 5-6 years ago. Having in mind that all of them developed their scientific interests working on the projects carried out at the Institute, it is reasonable to expect that they would significantly contribute to its future development.

After the first two years of the project cycle (Fundamental Research Programme funded by the Ministry of Science and Technological Development), which were very successful, many researchers employed at the Institute significantly improved their ranking in the categorization carried out in early 2008. Thirty two papers were published in the 2008 issues of international journals, whereas 15 were published or accepted for publication in the 2009 issues. Average number of papers published in journals indexed by *Thomson Scientific* per researcher is 1.5. Twenty five papers, making three-thirds of the total number, were published in journals whose impact factor is higher than 1; two of them were published in journals with an impact factor higher than 4.

Along with several technical inventions, one of which was awarded gold medal at the International Exhibition of Inventions, *New Technologies and Design INVENTIONS – BELGRADE 2008*, a patent application submitted by an international team including one of the researchers employed at the Institute was registered by the European Patent Organization. City of Belgrade Prize for achievements in the fields of natural and technical sciences in 2007 is a great honour for Institute's researchers involved in biomedical materials science and engineering.