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Introduction to the themed issue on Advanced Complex Inorganic Nanomaterials

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Energy, environmental issues and health care are amongst the top priorities of modern society. Such strategic issues have sparked phenomenal interest in inorganic nanomaterials as they hold great promise to develop new advanced devices and equipment which could revolutionise the way we live. Investigating the structuration of materials on the nanoscale has revealed unprecedented physical (optics, magnetism, *etc.*) and chemical (*e.g.* catalysis) properties that are absent in bulk matter of the same chemical composition. These specific functionalities are the consequence of a complex multi-level organisation (chemical, structural, textural) of the architecture of inorganic nanomaterials. The global properties and functional performances largely depend on the extent to which these levels are mastered during the synthesis process.

A new forum to discuss the evolution and extraordinary revolution brought by such nanomaterials was most welcome. This was the scope of the second International Conference on Advanced Complex Inorganic Nanomaterials (ACIN) held in Namur (Belgium), July 15–19, 2013, which was jointly organised by the Laboratory of Inorganic Materials Chemistry at the University of Namur and the Institute of Condensed Matter and Nanosciences (IMCN) at the University Catholique de Louvain. This meeting gathered an impressive set of renowned international speakers (Michael Graetzel, Zhong Lin Wang, Susumu Kitagawa, Mathias Driess, Xinhe Baho, Marie-Paule Pileni, Leone Spiccia, Lee Cronin, Min Gu, Paolo Samori, Mir Wais Hosseini, Shin-ichi Ohkoshi and Di Zhang, to name but a few) including Nobel Prize winner Jean Marie Lehn, who presented original results.

To celebrate this international inorganic chemistry event, *New Journal of Chemistry* (CNRS and RSC Publishing) present a themed issue gathering original contributions presented as 4 *NJC* Letters, 25 full papers, 4 Focus reviews and 6 Perspective reviews. This forum offers an update of recent innovations in both fundamental and applied aspects of inorganic nanomaterials (inorganics, ceramics, complexes, hybrids and bio-inspired materials).

The latest advances and progress on advanced preparation methods are discussed. In particular, hydrothermal routes are largely used to produce Bi_2WO_6 microspheres (Zhou *et al.*), $BaTiO_3$ tube-like arrays (Lamberti *et al.*), as well as $NH_4V_3O_8$ microcrystals or V_2O_5 (Vernardou *et al.*) and $H_2V_3O_8$ nanowire bundles (Han, Mai *et al.*) to improve electrochemical performances. Microwave assisted methods are employed to prepare $EuPO_4{\cdot}H_2O$ nanostructures (Tran Thu *et al.*) and layered simple hydroxides (Rogez *et al.*). Template assisted methods are followed to synthesise ZnO nanostructures/nanowires (Stassi, Cauda *et al.*) or porous BN and Si/B/C/N monoliths (Miele *et al.*). We can also point out an original self-assembly route combined with a ship-in-a-bottle method for mesoporous catalysts (Sun *et al.*), and a surface modification method to functionalize a graphite electrode (Toda, Hayami *et al.*). Finally, ion exchange methods to produce hollow micro/nanostructures materials are reviewed by Yan and Rosei.

The active field of coordination polymers (CPs)/MOFs and hybrids is also covered. In their review, Van der Voort *et al.* provide a useful survey of vanadium MOFs and their applications in adsorption, separation and catalysis, whereas Janiak, Henninger *et al.* highlight novel industrial applications of MOFs for heat transformation. Oshio *et al.* disclose the crystal structure of an achiral CP whereas Chen *et al.* present a flexible CP based on a rare heptanuclear Zn^{II} cluster featuring selective adsorption properties of alkylbenzene isomers, which are widely used in the chemical industry. Potential Mg precursors to MOFs are also presented (Wilson *et al.*). Non-siliceous hybrid organic–inorganic nanostructures are reviewed by Yuan *et al.* whereas Tremel *et al.* present

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the immobilisation of Au@MnO nanoflowers onto TiO_2 nanowires.

Spin crossover (SCO) nanomaterials are the focus of rising interest. Insights into complex cooperative mechanisms of SCO phenomena could be gained by Kitazawa *et al.* who present a Hofman like CP showing a two-step SCO with multiple phase transitions whereas Weber *et al.* have studied the effect of a short alkyl chain of amphiphilic Fe complexes. Halcrow surveys recent developments in the chemistry of 2,6-dipyrazol pyridine transition metal complexes and their SCO/luminescent properties. Other heterocycles are used either to reduce the metal–metal distance in dinuclear Ru^{II} complexes (Escriche, Albrecht *et al.*) or to prepare Fe^{III} polynuclear clusters with a ring structure (Clemente-León, Coronado *et al.*). Understanding thermal and photoswitchable SCO properties after size reduction is addressed respectively in the Focus reviews by Bousseksou *et al.* and Tissot. Tallon, Brooker *et al.* point out the importance of scan rate in the study of hysteretic Co SCO complexes whereas Ohkoshi *et al.* underline how relative humidity can tune hysteresis widths, which is of major importance for applications in display and data processing.

Several papers focus on heterogeneous catalysis. T. Zhang, Mou *et al.* investigate supported Au/Pd nanocatalysts, Lamonier *et al.* study hierarchically porous Nb–TiO_2 catalysts, whereas the effect of doping a titania catalytic support with vanadium oxide is reported by Siffert *et al.* Ru nanocrystal catalysts are described by J. Zhang, Ma *et al.* and Visart de Bocarmé developed impressive field emission techniques to study Pd and Pt nanocrystallites. Photocatalysis is also covered with Zn–TiO_2 mesoporous materials (Blin *et al.*) whereas Driess *et al.* stress the relevance of multi-faceted morphology of Ag_3PO_4 microparticles for water splitting. Other important properties are discussed: electrolytes (Laberty-Robert *et al.*) and photoanodes (Bein, Fattakhova-Rohlfing *et al.*) for dye-sensitised solar cells, plasmonic materials obtained with halloysite nanotubes decorated with Au (Hueso, Santamaría *et al.*) and a semiconducting charge transfer salt (Liu *et al.*).

From the large number of participants as well as from the appreciation received by the two chairmen, the success of this second edition of ACIN 2013 has been well recognised. Participants mentioned the highly stimulating exchange of ideas, the outstanding quality of the oral program and the impressive list of invited speakers, as well as the variety of themes and high level of organisation. 'A conference from which we learn and we are ready to revisit'. ACIN has raised high expectations within the nanomaterials community about the next edition of the series, which will soon be announced. We wish to take the opportunity to thank all contributors and reviewers, and sincerely hope that you will enjoy reading this themed issue.

