

New understanding may help fight drug-resistant bacteria

A group of Indian researchers at the Indian Institute of Technology (IIT) Bombay, Mumbai has made a breakthrough that might help fight drug-resistant bacteria¹. This knowledge might help fight drug-resistant bacteria in the future¹.

Ghosh and Sain¹ proposed a mechanism of Z-ring formation in *Escherichia coli*, bacteria that live in the human intestine. The Z-ring is made of filament temperature-sensitive Z (FtsZ) protein molecules and is responsible for generating the contractile force which leads to cleavage at the mid-cell.

Through simulations, they found that FtsZ molecules, anchor proteins and guanosine triphosphate (GTP) work in perfect harmony leading to radial con-

traction of the Z-ring. The FtsZ filaments have the ability to bind GTP and to hydrolyse it into GDT (guanosine diphosphate). The energetics of bending of the FtsZ filaments and lateral attraction between them cause net depolymerization on the outer periphery of the Z-ring and net polymerization on its inner periphery, making the Z-ring shrink concentrically towards the centre of the cell.

The Z-ring is attached to the cell wall, from the inside, through anchor proteins. Inward contraction of the Z-ring generates a contractile stress on the cell wall through anchors, resulting in the inward pulling of the cell wall in the form of a dividing septum.

This study suggests a new molecular target for possible antibiotics to control

bacterial growth or infection by controlling cell division, which can, in turn, be controlled by inhibiting the formation or contraction of the Z-ring.

Most of the antibiotics kill bacteria by rupturing their cell wall. But with many bacteria being antibiotic-resistant, this study may help in designing new drugs targeting the Z-ring rather than the cell wall.

1. Ghosh, B. and Sain, A., *Phys. Rev. Lett.*, 2008, **101**, 178101.

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MEETING REPORT

Mechanochemistry and mechanical alloying*

The International Conference on Mechanochemistry and Mechanical Alloying (INCOME) series was initiated by the International Mechanochemistry Association (IMA; an associate member of the International Union of Pure and Applied Chemists (IUPAC)) in order to provide a common platform for researchers from academia, R&D organizations and the industry to discuss issues related to mechanochemistry and mechanical alloying. The first international conference INCOME-1992, was held in Koásice (Slovakia) in 1992 and it was followed by INCOME-1997 in Novosibirsk (Russia), INCOME-2000 in Prague (Czech Republic), INCOME-2003 in Braunschweig (Germany), and INCOME-2006 in Novosibirsk (Russia).

The sixth international conference, INCOME-2008 was held in India. There were nearly 250 delegates, including 60 from abroad. There were about 80 oral

and 50 poster presentations during this conference. An exhibition was also organized where state-of-the-art milling devices and characterization equipment were displayed. The discussion and the technical presentation revolved around topics ranging from mechanochemistry of macromolecules and applications in pharmaceuticals, severe plastic deformation and friction stir welding, mechanical alloying and advanced materials, nanoparticles and nano-composites, advance ceramics science and technology, mineral processing, extractive metallurgy, and to waste and environment management. Details about the conference and the abstract of papers are available at the website: www.income2008.org. Here I highlight some of the important issues emerging out of this conference.

While welcoming the delegates, S. P. Mehrotra (National Metallurgical Laboratory (NML), Jamshedpur, and Chairman, INCOME-2008) elaborated upon the significance of mechanochemistry as an evolving discipline and talked about its fundamentals, applications as well as unsolved and challenging issues. While inaugurating the conference, T. Rama-

sami (Department of Science and Technology, New Delhi) discussed how nature has employed several principles of mechano-chemistry and synthesized nano-size materials. It was emphasized that the natural nanosized structures like skin for perspiration and transpiration, peacock feather for decoration, and shells and bones for protection and load-bearing functions are yet to be replicated by scientists. Peter Balaz (Slovakia), founding member of the IMA dealt with issues related to the application of mechanochemistry in mineral processing, extractive metallurgy, chemical engineering, building industry, coal industry, materials engineering, agriculture, pharmacy and waste management.

Horst Hahn (Germany) discussed the structural stability and plasticity of nano-sized metals and alloys. He also pointed out the difficulties in controlling the grain growth in the case of nanophase materials. It was demonstrated that by the suitable segregation of elements, grain coarsening can be controlled, for example, Zr in Pd and Fe nanocrystals. K. A. Padmanabhan (Anna University, Chennai) presented an overview of ultra

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fine-grained materials through mechanical processing and pointed out the challenges ahead to fully understand the process of severe plastic deformation and to model it successfully for industrial exploitation. Plastic deformation of fully dense Pd nanocrystals of grain size 10–30 nm was discussed by H. J. Fecht (Germany). *In situ* investigation during plastic flow of nanocrystalline materials has revealed by the formation of shear bands, cooperative grain boundary sliding and fractography. K. L. Murty (USA) presented work on creep behaviour of ball-milled nanocrystalline aluminum samples of 23 nm size. From this experiment it was found that the apparent activation energy was lower than that for grain-boundary diffusion. M. Ghosh (NML) discussed the evolution of interface microstructure during friction-welded aluminum–stainless steel plate.

E. Boldyreva (Russia) discussed mechanochemistry of individual molecules, mechanochemistry of phase transitions, mechanochemical synthesis of new compounds and molecular co-crystals, and mechanochemical extraction of bioactive molecular compounds from natural resources and wastes. G. R. Desiraju (University of Hyderabad) described how the mechanical properties of crystals could be used to quantify intermolecular interactions. Ashwini Nangia (University of Hyderabad) discussed the design aspect of pharmaceutical co-crystals, which are understood to be solid-state molecular complexes of two or more components. C. Malla Reddy (IISER, Kolkata) discussed in a systematic manner, the structure–property correlations in shearing, bending and brittle organic crystals. K. G. Korolev (Russia) presented work on the transformation of bio-cell morphology during mechanical activation. T. P. Shakhshneider (Russia) dealt with mechanochemistry and solubilization of drugs. He explained dissolution studies in the case of mechanocomposites. T. T.

Frišćić (UK) discussed the development of liquid-assisted grinding for the synthesis of hydrogen-bonded and coordination frameworks.

B. K. Misra (IMMT, Bhubaneswar) dealt with the efficient synthesis of nanocrystalline cementite by reaction milling using a dual-drive planetary mill with a centrifugal field of 30–40. G. I. Manna (IIT, Kharagpur) elaborated upon mechano-chemical synthesis of Al-based nanocrystalline/amorphous alloys for high specific strength applications. M. Besterci (Slovakia) dealt with mechanical alloying of Al–C system and synthesized Al–Al₄C₃ composites by mechanical alloying of Al and graphite. D. Bhattacharjee (Tata Steel) discussed the use of nanofluids as coolants in steel industries. He demonstrated that nanofluids consisting of nanoparticles or nanofibres with sizes typically 1–100 nm suspended in liquid, have many interesting and unique properties in terms of thermal conductivity and heat transfer. B. S. Murty (IIT Madras) threw light on how high-energy ball milling has established itself as a viable and versatile route for the synthesis of nanomaterials. N. K. Mukhopadhyay (Banaras Hindu University, Varanasi) discussed the evolution and stability of nanocrystalline and amorphous phases in complex metallic alloys, including quasi-crystals during mechanical milling. It was shown that it is not possible to reduce the grain size by mechanical milling below a certain limit.

P. Ramachandra Rao (ARCI, Hyderabad) presented the thermodynamic and kinetic aspects for the formation of glassy phases during mechanochemical processing. He emphasized that the nucleation and growth of the phase transformation during the driven condition can be modelled similarly, as in the case of equilibrium transformation. Local structure and size-dependent properties of nano-oxides prepared by mechanochemical routes were presented by V.

Šepelák (Braunschweig University of Technology, Germany). J. Foct (Université de Lille, France) discussed mechanically driven atomic distributions in interstitial alloys in general. He also pointed out that ballistic mode of diffusion may not be required for understanding the transformation in the present case. S. Srikanth (National Metallurgical Laboratory Madras Centre) illustrated the partitioning of energy input during high-energy mechanical milling. The experimentally determined crystallite size and strain correlated well with the values estimated from line-broadening analysis. P. P. Chattopadhyay (BESU, Howrah) demonstrated blue–violet photoluminescence from a colloidal suspension of nanocrystalline silicon–silicon oxide matrix prepared by ball milling.

During the concluding session, it was recognized that mechanochemistry and mechanical activation have evolved as one of the frontier areas of research and application. Significant developments have taken place in terms of scientific understanding and applications in diverse fields encompassing all facets of metallurgy, including metal extraction, alloying and composites; traditional and advanced ceramics processing; paints, pigments; and dyes; catalysis; pharmaceuticals agriculture; utilization of wastes; energy and environment. It was decided to bring out a conference proceedings containing important contributions. The selected papers after peer-reviewing will be published in the form of a book. It was also mentioned that the next INCOME would likely to be held in Europe some time in 2011.

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