Chemical Nanotechnologies:
From Molecules to Functional Nanostructures for Energy and Health Applications

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Chemical nanotechnologies have played, in the past few decades a major role in the convergence of life, physical and engineering sciences leading not only to simple collaboration among the disciplines but to a paradigm shift based on true disciplinary integration. The successful synthesis, modification and assembly of nanobuilding units such as nanocrystals and wires of different materials have demonstrated the importance of chemical influence in materials synthesis, and have generated great expectations for the future. Implications of chemistry as an innovation motor are now visible for knowledge leap forward in various sectors such as materials engineering for energy, health and security.

Inorganic nanostructures inherit promises for substantial improvements in materials engineering mainly due to improved physical and mechanical properties resulting from the reduction of microstructural features by two to three orders of magnitude, when compared to current engineering materials. This talk will present how chemically grown nanoparticles, nanowires and nanocomposites of different metal oxides open up new vistas of material properties, which can be transformed into advanced material technologies. The examples will include application of superparamagnetic iron oxide nanoparticles for magnetic resonance imaging (MRI) and drug delivery applications, vapour phase synthesis and electrospinning of nanowires for application as electrode materials and in water splitting reactions (for solar hydrogen production). A novel sensing concept based on the integration and correlation of complementary functionalities originating from multiple junctions in a singular nanostructure to palliate the current issues in gas sensor technologies such as low power consumption, low operating temperature and cost effective production will be elaborated. Finally, the current challenges of integration of nanomaterials in existing device concepts will be discussed.

Sanjay Mathur is the Director of the Institute of Inorganic Chemistry at the University of Cologne in Germany. He is also the Director of the Institute of Renewable Energy Sources at the Xian Jiao Tong University, Xian, China and a World Class University Professor at the Chonbuk University in Korea. He also holds Visiting Professorships at the Central South University, China and National Institute of Science Education and Research, India.

His research interests focus on application of nanomaterials and advanced ceramics for energy technologies. He holds six patents and has authored/ co-authored over 300 original research publications and has edited several books. He is a Titular Member of the International Union of Pure and Applied Chemists (IUPAC) and a member of the ISO Technical Committee on Nanotechnologies. He serves as the Editor for *Journal of Electroceramics*, and as the Principal Editor of *J. Mater. Research*. He is also an Associate Editor for *International Journal of Applied Ceramics Technology*, *International Journal of Nanoscience* and *Nanomaterials*. He is also on the Editorial Boards of journals *International Journal of Nanotechnology, Materials, Journal of Ceramic Science and Technology*, and *NanoEnergy*.

He is an Academician of the *World Academy of Ceramics* and *Fellow* of the American Ceramic Society. He also acts as the "*International Ambassador*" of the University of Cologne. He is a member of the Advisory Board of the Federation of German Materials Science (DGM) and also serves on the Board of the German Chemical Industries Network CHEMCOLOGNE. He is appointed on the Review Advisory Panel of the CSIR, South Africa and also serves as International Advisor to Korean Institute of Industrial Technology (KITECH), Incheon, Korea and Vice-President of the Thin Film Society, Singapore.