9th World Congress on

Materials Science and Engineering

June 12-14, 2017 Rome, Italy

Keynote Forum

Day 1

Robert Huber, J Material Sci Eng 2017, 6:4(Suppl)
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Robert Huber[1,2,3]

[1]Max Planck Institute of Biochemistry, Germany

[2]Technical University of Munich, Germany

[3]University of Duisburg-Essen, Germany

New ways of vision: Protein structures in translational medicine and business development - My experience

As a student in the early nineteen sixties, I had the privilege to attend winter seminars organized by my mentor, W Hoppe, and by M Perutz, which took place in a small guesthouse in the Bavarian, Austrian Alps. The entire community of a handful of protein crystallographers assembled in a room which served as living and dining room and as auditorium for the lectures. Today structural biologists organize large congresses with thousands of attendants and there exist many hundreds of laboratories specialized in this field. It appears to dominate biology and biochemistry very visibly if we count covers in scientific journals displaying macromolecular structures. Structural biology was successful, because it was recognized that understanding biological phenomena at the molecular and atomic level requires seeing those molecules. Structural biology revealed the structure of genes and their basic mechanism of regulation, the mechanism of enzymes' function, the structural basis of immune diversity, the mechanisms of energy production in cells by photosynthesis and its conversion into energy- rich chemical compounds and organic material, the mechanism that makes muscle work, the architecture of viruses and multi-enzyme complexes, and many more. New methods have an essential impact on the development of structural biology. Methods seem to become available in cadence with the growing complexity of the problems and newly discovered methods bring biological problems within reach for researchers, a co-evolutionary process of the development of methods and answerable problems, not only in the field of X-ray diffraction, but also in optical microscopy, nuclear magnetic resonance, and electron microscopy. An important additional incentive for structural biology came from its potential application for drug design and development using knowledge of drug receptor structures at the atomic level combined with theoretical approaches of ligand binding. The commercial interest in application spurred this direction of research enormously. My lecture will focus on protein crystallography and start out with the major factors contributing to its development. Few examples shall illustrate how structure information contributes to our understanding of the physical and chemical basis of biological phenomena and may lead to medical application. I then will let you share my experience with the foundation and development of two biotech companies with different business models, but both based on basic academic research in structural biology: Proteros (www.Proteros.com) offers enabling technology services for pharma- and crop science companies imbedding all steps of the workflow molecular and structural biology can provide and commands and uses its platform for the generation of leads from identified targets to in vivo Proof-of-Concept (PoC). Suppremol (www.Suppremol.com) specializes in the development of novel immune-regulatory therapeutics for the treatment of autoimmune diseases on the basis of a recombinant, soluble, non-glycosylated version of the human Fcg receptor IIB and of receptor binding antibodies. Suppremol was recently acquired by Baxter International Inc. (NYSE:BAX) offering an ideal setting for its therapeutic projects.

Biography

Robert Huber is Director at the Max Planck Institute for Biochemistry, where his team developed methods for the crystallography of proteins. In 1988, he received the Nobel Prize for Chemistry jointly with Johann Deisenhofer and Hartmut Michel. Three were recognized for their work in first crystallizing an intra-membrane protein important in photosynthesis in purple bacteria, and subsequently applying X-ray crystallography to elucidate the protein's structure. The information provided the first insight into the structural bodies that performed the integral function of photosynthesis. This insight could be translated to understand the more complex analogue of photosynthesis in cyanobacteria which is essentially the same as that in chloroplasts of higher plants. In 2006, he took up a post at the Cardiff University to spearhead the development of structural biology at the university on a part-time basis. Since 2005, he has been doing research at the Center for Medical Biotechnology of the University of Duisburg-Essen. He was one of the original editors of the "*Encyclopedia of Analytical Chemistry*".

huber@biochem.mpg.de

Zhong Lin Wang, J Material Sci Eng 2017, 6:4(Suppl)
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Zhong Lin Wang[1,2]

[1]Georgia Institute of Technology, USA

[2]Beijing Institute of Nanoenergy and Nanosystems, CAS, China

Nanogenerators for self-powered systems and piezotronics for artificial intelligence

Developing wireless nanodevices and nanosystems is of critical importance for sensing, medical science, environmental/infrastructure monitoring, defense technology and even personal electronics. It is highly desirable for wireless devices to be self-powered without using battery. Nanogenerators (NGs) have been developed based on piezoelectric, trioboelectric and pyroelectric effects, aiming at building self-sufficient power sources for micro/nano-systems. The output of the nanogenerators now is high enough to drive a wireless sensor system and charge a battery for a cell phone, and they are becoming a vital technology for sustainable, independent and maintenance free operation of micro/nano-systems and mobile/portable electronics. An energy conversion efficiency of 55% and an output power density of 500 W/m^2 have been demonstrated. This technology is now not only capable of driving portable electronics, but also has the potential for harvesting wind and ocean wave energy for large-scale power application. This talk will focus on the updated progress in NGs. For wurtzite and zinc blend structures that have non-central symmetry, such as ZnO, GaN and InN, a piezoelectric potential (piezopotential) is created in the crystal by applying a strain. Such piezopotential can serve as a "gate" voltage that can effectively tune/control the charge transport across an interface/junction; electronics fabricated based on such a mechanism is coined as piezotronics, with applications in force/pressure triggered/controlled electronic devices, sensors, logic units and memory. By using the piezotronic effect, we show that the optoelectronic devices fabricated using wurtzite materials can have superior performance as solar cell, photon detector and light emitting diode. Piezotronics is likely to serve as a "mechanosensation" for directly interfacing biomechanical action with silicon based technology and active flexible electronics. This lecture will focus on the updated progress in the field and its expansion to 2D materials.

Biography

Zhong Lin Wang is the hightower Chair in Materials Science and Engineering, Regents' Professor at Georgia Tech, and Director of Beijing Institute of Nanoenergy and Nanosystems. He has made original and seminal contributions to the synthesis, discovery, characterization and understanding of fundamental physical properties of oxide nanobelts and nanowires, and their applications in energy sciences, sensors, electronics and optoelectronics. His discovery and breakthroughs in developing nanogenerators establish the principle and technological road map for harvesting mechanical energy from environment and biological systems for powering mobile sensors. He first showed that the nanogenerator is originated from the Maxwell's displacement current, revived the applications of Maxwell's equations in energy and sensors. His research on self-powered nanosystems has inspired the worldwide effort in academia and industry for harvesting ambient energy for micro-nano-systems, which is now a distinct disciplinary in energy science for future sensor networks and internet of things. He coined and pioneered the fields of piezotronics and piezo-phototronics by introducing piezoelectric potential gated charge transport process in fabricating strain-gated transistors for new electronics, optoelectronics, sensors and energy sciences.

zlwang@gatech.edu

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Day 2

Michael F Herman, J Material Sci Eng 2017, 6:4(Suppl)
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Michael F Herman

Tulane University, USA

An approximate semi-classical method that uses real valued trajectories for time dependent tunneling calculations

A semi-classical method will be presented that describes the time dependent tunneling of a quantum wave packet encountering a barrier. Tunneling through barriers plays a significant role in many reactions. The method described in this talk uses an approximation to the standard semi-classical stationary phase method. The approximation employed in this work leads to real valued tunneling trajectories, while most methods for this problem employ complex valued trajectories. Using only real valued trajectories will have significant advantages in applications to larger systems. It is found that there are typically three of these approximate stationary phase contributions to the wave function for each point r in the transmitted region. Two of these have energies very close to the barrier top, one slightly above the barrier top and the other slightly below it. The third approximate stationary phase contribution is at a lower energy. Difficulties in obtaining accurate values for the contributions from trajectories with energy very close to the barrier top will be considered, and the accuracy of the approximate stationary phase wave function will be discussed.

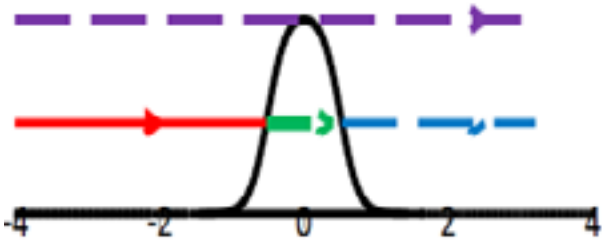

Figure 1: A particle flux (red curve) encounters a potential energy barrier (black curve) and tunnels through the barrier (green curve) and a diminished flux emerges on the other side of the barrier (blue) curve.

Biography

Michael F Herman received his PhD in Theoretical Chemistry from the University of Chicago in 1980. He has been on the Faculty of Tulane University since 1981. His work has focused on the development of semi-classical methods for modeling chemical systems. He also has developed a model for polymer dynamics in the melt, and is studying the influence of intermolecular dipolar couplings between molecular vibrations on isotopic fractionation processes.

mherman@tulane.edu

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Karl Ulrich Kainer, J Material Sci Eng 2017, 6:4(Suppl)
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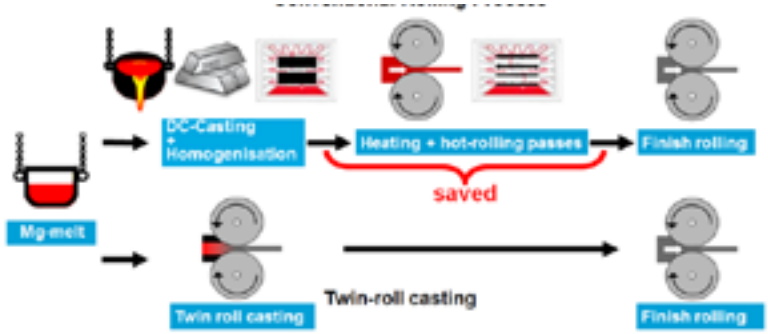
Karl Ulrich Kainer

Helmholtz-Zentrum Geesthacht, Germany

Implementation of new magnesium sheets into application from laboratory to service

In the recent years, Mg alloys have made inroads into applications in transportation industries. Their favorable property profile like high specific strength, good machinability, recyclability promotes increased usage. Despite magnesium alloys being in service for almost 100 years, there is still a lack of knowledge regarding the potential of Mg alloys. New alloys and new or optimized processes are creating new ideas to substitute traditional materials. However, the implementation of new alloys and advanced processes has many hurdles and hindrances like: Market issues - Price, costs, availability, readiness for market etc.; completeness of the development, unsuitable processes for upscaling from laboratory to industrial scale; inadequate properties after upscaling i.e. strength, ductility, corrosion behavior, crash worthiness; and life cycle assessment issues. In this presentation one example will be discussed: Issues of the implementation of new magnesium sheets for automotive applications.



Biography

Karl Ulrich Kainer has studied Materials Science from the University of Applied Science Osnabrueck and Clausthal University of Technology. He obtained his PhD degree in Materials Science from Clausthal University of Technology in 1985 and his Habilitation in 1996 on Magnesium Matrix Composites. From 1985 to 1999, he was the Head of the Light Metal, P/M and Composite Group at the Institute for Materials Science and Technology. Since 2000, he is the Director of the Institute of Materials Research and the Magnesium Innovation Centre at Helmholtz-Zentrum Geesthacht and Professor for Materials Technology, Hamburg University of Technology. He has over 30 years of experience working in the area of Light Metals (Al, Mg and MMC's). He has published more than 320 ISI-listed publications and more than 400 Publications in proceedings and non JCR listed journals. He is member of a number of professional organizations (ASM Int., TMS, German Society of Materials (DGM), Association of German Engineers (VDI) and ASTM Int.) He is Member of the Board of Directors and the Executive Committee of the International Magnesium Association (IMA).

karl.kainer@hzg.de

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Gilbert Daniel Nessim

Bar Ilan University, Israel

Towards the growth of 3D forests of carbon nanotubes: Selective height control using reservoirs and overlayers

Despite the massive progress achieved in the growth of carbon nanotube (CNT) forests on substrate, besides lithographic patterning of the catalyst, little has been done to selectively (locally) control CNT height. Varying process parameters, gases, catalysts, or overlayer materials uniformly affects CNT height over the whole substrate surface. We will show here how we can locally control CNT height, from no CNTs to up to 4X the nominal CNT height from iron catalyst on alumina underlayer by patterning reservoirs or by using overlayers during annealing or growth. We pioneered the concept of reservoir showing how an iron thin film reservoir placed below the alumina underlayer almost doubles CNT height and how a copper/silver thin film reservoir deactivates the iron catalyst placed above it. We will also show how different thin film reservoir materials can enhance CNT growth by a factor of 4X. We also pioneered the concept of overlayer, where a copper stencil or bridge placed above the catalyst surface during pre-annealing or during CNT growth deactivates the catalyst. We showed how we could pattern regions with CNTs and without CNTs by simply annealing the sample with a patterned overlayer positioned above its surface. Using nickel overlayers, we obtained a similar result but with a completely different mechanism. We thus synthesized patterned CNT forests using a simple process, without the need for lithography. We can now combine the overlayer technique with one of the above-mentioned reservoirs (no reservoir, Cu/Ag reservoir, or Fe reservoir) to further modulate CNT growth by offsetting some or all of the growth enhancements achieved using the reservoirs. This modulation of the CNT height is a significant improvement compared to the "CNTs (one height)/no CNTs" patterning that has been achieved using lithography of the catalyst, and moves us closer to building 3D architectures of CNTs.

Biography

Gilbert Daniel Nessim heads a laboratory at Bar Ilan University (Israel) that focuses on the synthesis of nanostructures using state-of-the-art chemical vapor deposition equipment. The scientific focus is to better understand the complex growth mechanisms of these nanostructures, to possibly functionalize them to tune their properties, and to integrate them into innovative devices. He joined the Faculty of Chemistry at Bar Ilan University in 2010 as a Lecturer and was promoted to a Senior Lecturer in 2014. He holds a PhD in Materials Science and Engineering from the Massachusetts Institute of Technology (MIT), an MBA from INSEAD (France), and Master's degree in Electrical Engineering from the Politecnico di Milano and from the Ecole Centrale Paris (ECP, within the Erasmus/TIME program).

gdnessim@biu.ac.il