PolyU Spearheads Research in Nanostructured Materials

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(PRWEB) April 4, 2009 -- The Hong Kong Polytechnic University (PolyU) has recently received research funding totaling more than $9 million from the Research Grants Council (RGC), the Innovation and Technology Fund (ITF) and industry partners to advance the study of nanostructured materials on both theoretical and technological application sides.

The grants will support two nanotech projects led by Prof. Lu Jian, Chair Professor and Head of PolyU's Department of Mechanical Engineering. The project funded by ITF-affiliated "Nano and Advanced Materials Institute Ltd" (NAMI) is expected to benefit the aerospace and steel industries; while the collaborative research supported by RGC will help demystify the underlying principle of nanostructure and establish related theory. Theories and multiscale numerical simulation tools will be developed from molecular level to macroscopic structural level that could be applied to car and aircraft.

In carrying out the ITF NAMI-funded project entitled "Development of the Layered Nanostructured Metallic Sheet/Plate for Structural Applications", PolyU has also won the support of two industry partners, namely the famous Baosteel Group Company of China and the European Aeronautic Defence and Space Company. Both are Fortune 500 companies while the latter is a global leader in aerospace, defence and related services.

Prof. Lu said this partnering has enabled PolyU to enhance its leading position in the technology of nanomaterials research for structural applications. He will lead a team to explore the potential of their newly-developed nanomaterials in structural applications for different targeted industrial sectors. The platform to be applied in their investigation of residual stress distribution measurement in nanostructured materials is unique in the world. Its application is also far-reaching and could be extended to other alloys and composites based on nanocrystalline materials or amorphous materials.

To better understand the underlying mechanism of the nanostructured generation of materials and its multiscale failure modes, Prof. Lu is also taking the lead in studying the "Design and Realization of Structural Materials with High Strength and High Ductility" together with nanotechnology experts from the Hong Kong University of Science and Technology, the Chinese University of Hong Kong and the University of Hong Kong. Through this project, the team will collaborate with three internationally well-known institutions from the US and France (namely the University of California at Berkeley, Pennsylvania State University in the US; and INRIA, the French national institute for research in computer science and control).

The project will address four key issues that would emerge when integrating the nanostructured materials for structural applications. They are (1) Improving the ductility of nanostructured materials and producing the materials at large scale; (2) Development of advanced numerical simulation tools for studying two highly conflicting key mechanical properties: Strength and Ductility; (3) Development of advanced experimental methods for investigating the fundamental fracture mechanisms; and (4) Development of joining technology for nanostructured materials using "Pulsed Laser Welding", and to optimize the welding conditions for conserving the nanostructures and the strength of the nanostructured materials.
Prof. Lu is a pioneering researcher in the fields of material science and engineering, mechanical engineering and mechanics. In studying nano-scale structural materials, the research teams led by Prof. J.Lu and his collaborator Prof. K.Lu (IMR, CAS) put forward the idea of "Nitriding Iron at Lower Temperatures" to refine the microstructure on the surface layer of an iron plate, and the article was published in the Science Magazine (January 31, 2003 issue). He also co-invented the SMAT together with Prof. Lu Ke of the Chinese Academy of Sciences with several issued patents in Europe, USA and China.

The sophisticated SMAT process could bring about a change in surface microstructure through generating an in-situ nanocrystalline layer on the surface of bulk metal. While most surface-modification techniques for solid materials are based on chemical reactions, SMAT seeks to reduce the grains sizes down to nanometer scale on the top surface layer through random mechanical plastic deformation. Hence this process represents a new approach to modify the properties and functionalities of the surface layer of materials.

This advanced technique can be combined with traditional work surface treatment methods to improve the mechanical properties of materials. It is applicable to producing advanced composite materials for a wide range of industries, including automotive, aerospace, civil structures, machinery, power generation, and bio-medical industry.

Over the years, Prof. Lu has received numerous honours for his breakthroughs. In 2006, he was awarded "The French Knight Order of National Merit" (Chevalier de l'Ordre National du Merite) by the French Government in recognition of his illustrious research and academic achievements. He further received a Gold Medal with Mention and a Special Prize in the 2007 Brussels Eureka Expo - The 56th World Exhibition of Invention, Research and Industrial Innovation for his invention "Nanostructured Materials Generation System - SMAT".

The two new research projects will continue the research work carried out by the Department of Mechanical Engineering since 2005, under the niche area scheme in the field of nanotechnology research with a focus on the Product Engineering through the Integration of Advanced and Nano-materials in Design. It will enhance the research capacity and ensure the worldwide leadership of PolyU in this research area of structural nano-materials in the future.

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