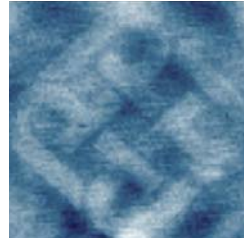


## Opening Positions Available !

Right:

This PolyU logo was created by final year students using “oxidation nanolithography” technique. Its overall dimension is less than 1/200 of the thickness of a human hair. Nanolithography is a new frontier of modern technology. It has potential applications such as information storage, micro- and nano- devices for computing, medicine, and aerospace technologies.



350nm×350nm

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**San-Qiang Shi**  
Professor

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M.Sc.(1984, USTB), B.Sc.(1982, USTB)

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(This page was updated on January 1, 2007)

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## Corrosion and Surface Technology Laboratory (GH702)

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The newly established, state-of-the-art Corrosion and Surface Technology Laboratory echoes HKSAR's call on cleaning up the environment and supports teaching, consultancy and research activities on the environmental degradation and protection of materials. The laboratory has been equipped with the following facilities:



### **Surface characterization:**

- scanning probe microscopy (SPM) under elevated temperature up to 300 °C as well as selective gas/liquid environment with following modes: STM/STS/contact AFM/LFM/Resonant Mode (semicontact AFM + noncontact AFM)/Phase Imaging/ Force Modulation/Spreading Resistance Imaging/MFM/EFM/SCM/SKM/Adhesion Force Imaging/AFM, STM, voltage, RM Lithography Modes
- near-field scanning optical microscopy (SNOM)
- high-resolution optical microscopy
- image analysis system

- surface roughness analyzer
- coating thickness tester



### **Surface mechanical testing:**

- nano-indentation system with in-situ AFM (nano-hardness, nano-scratch/wear, friction coefficient, elastic modulus, fracture toughness, delamination, dynamic loading & dynamic stiffness measurement, effect of temperature up to 150 °C and fluid)
- micro-mechanical strength tester for Scanning Probe Microscopy with force from sub-gram to 100 lbs in tension, compression and fatigue modes
- micro-hardness system
- micro-scratch & wear
- falling weight impact tester
- Taber abrasion tester
- adhesion cross-cut tester



### **Corrosion testing facilities:**

- electrochemical systems with maximum resolutions of 0.01 fA and 1  $\mu$ V, healthy output of  $\pm 750$  mA at  $\pm 12$  V, and frequency range of 10  $\mu$ Hz to 100 kHz

- thermogravimetry analysis systems (TGA) with a maximum temperature of 2400 °C under controlled gaseous and/or humid environments, plus simultaneous measurements of differential scanning calorimetry (DSC) or differential thermal analysis (DTA)
- environmental chambers for mechanical testing (tensile, torsion and fatigue) under elevated temperature or moisture conditions (in collaboration with Strength of Materials Laboratory)



**Coating and sample preparation facilities:**

- spin so-gel coating system
- mechanical mixers
- spray gun
- digital hot plates
- digital balances from 0.001g to 150 lbs
- programmable oven
- automatic polishing machine
- diamond cutting machine
- hot sample mounting machine

**Data processing facilities:**

- Dec-alpha station (dual CPU 667 MHz, 4 GB RAM, 75 GB Hard Disk)
- Pentium PCs with LCD monitors
- LaserJet network printer, high resolution color printer and scanner

Student final year projects at Corrosion and Surface Technology Laboratory (2000~2001)

- Comparison of Coating Materials for Civil Structures;
- Development of A Fuel Cell for Small Electronics Application;
- **Surface and Interface Properties of Smart Materials Composite (short listed by HKIE for best final year project report);**
- Aging Effect on a Ni-Fe Based Alloy (co-sponsored by CLP);
- Surface Treatment & Shot Peening on Aircraft Components;
- Surface Elastic & Damaging Properties of Metal Hydrides;
- Internet Technology in Surface & Materials Science;
- IGARD Surface Coating Project.

Student final year projects at CSTL (2001~2002)

- 3-D Microstructure and Chemical Analysis of Turbine Blade (co-sponsored by CLP);
- Aging Effect of Hastelloy-X (co-sponsored by CLP);
- **Fatigue and Fracture Analysis of Axle (co-sponsored by KCRC, nominated to HKIE for best final year project report);**
- Oxidation Behavior of Smart Materials;
- Mechanical Properties of Hydrogen Storage Materials Using Nano-indentation Technology.

Student final year projects at CSTL (2002~2003)

- Development of Nanostructures Using Dip-Pen Nanolithography;
- Micro and Nano Patterning Using AFM Induced Oxidation Technique;
- **Wearing Properties of KCR Train Wheels (co-sponsored by KCRC, nominated to Fung's Industrial Prize for best final year project);**
- **Corrosion and Oxidation Behavior of Shape Memory Alloys (Winner of IMechE best final year project in Hong Kong, also nominated to Fung's Industrial Prize for best final year project).**

Student final year projects at CSTL (2003~2004)

- Nano-lithography;
- Mechanical properties of carbon nanotube and its composites;
- Nanowire formation and oxidation in metals;
- Corrosion analysis of display frame coatings (co-sponsored by local industry);
- Analysis of structural use of polycarbonate (co-sponsored by MIDI Aluminum Fabricator Ltd).

Student final year projects at CSTL (2004~2005)

- Nano-patterning with dip-pen nanolithography;
- Fatigue cracks in centre pivot (co-sponsored by KCRC, **nominated for Fung's Industrial Prize**);
- Evaluation of surface treatment on stainless steel ball pen (co-sponsored by Lotus Stationary Company);

- Design and evaluation of automatic tube cleaner robot for condenser cleaning of chillers (co-sponsored by Electrical and Mechanical Service Department of HKSAR).

Student final year projects at CSTL (2005~2006)

- Gas sensor made by metal oxide nanowires;
- Design of swing speed detector for golfers;
- Design of wind speed detector & attack angle corrector for golfers (**nominated for Fung's Industrial Prize**);
- Development of friction and wear measurement apparatus.

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## Research Interests

- Nanolithography: research and development of micro- and nano- structures using Scanning Probe Microscopy such as AFM (in collaboration with Prof. Charles Surya of EIE, PolyU, Dr. A.B. Djuricic of Physics, HKU);
- Phase-field Modeling of phase transformation and morphology evolution under externally applied fields (in collaboration with [Prof. L.Q. Chen](#) of Penn. State University, and Prof. X.Q. Ma of USTB); ([simulated morphology evolution of hydride precipitation under tensile stress as function of time](#), and [movies on grain growth](#))
- Development of Micro-Finite Element Model for Quantifying Mechanical Properties of Trabecular Bone (in collaboration with Dr. M Zhang of REC at PolyU, Prof. L QIN of Orthop. & Traum. at CUHK);
- Mechanical properties of advanced carbon nano-materials (in collaboration with Prof. H.M. Cheng of Institute for Metal Research, Prof. R. Yang of IMR, and Dr. L.G. Zhou of RPI, and with Dr. K.T. Lau of PolyU); ([movie1](#), [movie2](#), [movie3](#) on nanotubes)
- Failure Behavior of Conducting and Insulating Cracks in Ferroelectric Ceramics under Electrical, Mechanical and Chemical Loading (in collaboration with Prof. T.Y. Zhang of HKUST, and Prof. L.J. Qiao of USTB);
- Modeling of mechanical properties of engineering materials and defect interaction in solid crystals from atomic scale to macro scale (in collaboration with Prof. C.H. Woo of PolyU); ([movie1](#), [movie2](#), [movie3](#) on defects)
- Delayed hydride cracking and hydride properties in zirconium alloys (in collaboration with Dr. M.P. Puls of [AECL](#));
- Theoretical studies on criteria for fracture initiation in engineering materials (in collaboration with Dr. K.T. Lau and Prof. L.M. Zhou of PolyU);
- Modeling of nonlinear diffusion under stress and/or temperature gradients;
- Oxidation and corrosion of engineering materials;
- Hydrogen permeation, trapping, and induced cracking in structural materials.

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### **Consultancy Interests**

- Environmental degradation and protection of structural materials, aging problems in power plants
- Computer-aided materials & product design
- Surface coating technology

### **Past and Current Consultancy Projects**

- Analysis of Collapse of Mobile Crane for Asia Pacific Adjusters Ltd.;
- Replacement and Rehabilitation of Water Pipe Coating for Hong Kong Water Supply Department;
- Internal coating project for GEW;
- Failure analysis of a broken water pipe for Hong Kong Water Supply Department;
- Failure analysis of cranes for Hong Kong Construction Co.;
- Mechanical Properties of Zinc Came for Golden Enterprises Ltd.;
- Failure of an oil supply pipe in diesel engine for Hong Kong Ferry Ltd.

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## Teaching Courses

- ME 206: Materials Selection and Design
- ME 263: Engineering Materials A
- ME 362: Mechanics of Solids
- ME 412: Non-Destructive Evaluation of Materials
- ME 414: Environmental Degradation of Materials
- ME 520: Theory of Plasticity
- ME 542: Pollution, Its Prevention and Control
- ME 538/571: Corrosion Control
- ME 550: Materials and Smart Structural Design
- ENG 225: Introduction to Engineering
- ENG232: Engineering Science
- ENG 240: Materials Technology for Products
- Complementary Study: Introduction to Micro & Nanotechnology

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## Academic & Industrial Experiences

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### Education

- **Post Doctoral Fellow**, Materials Science and Engineering, McMaster University, 1991;
- **Ph.D.**, Materials Science and Engineering, McMaster University, Canada, 1991;
- **M.Sc.**, Applied Physics, University of Science and Technology Beijing, China, 1984;
- **B.Sc.**, Applied Physics, University of Science and Technology Beijing, China, 1982.

### Awards

- **Research Grant Achievement Award**, FENG of PolyU, 2005;
- **Merit Award in Research and Scholarly Activities**, FENG of PolyU, 2003;
- **Research Grant Achievement Award**, FENG of PolyU, 2003;
- **Chinese National Education Commission Visiting Scholarship**, 2000~2001;
- **Natural Science and Engineering Research Council of Canada Post Doctoral Fellowship**, 1991;
- **Canadian International Development Agency Scholarship**, 1986-1991;
- **Top Outstanding Graduate Prize**, University of Science and Technology Beijing, 1982.

### Research & Other Grants (PI = Principal Investigator; CoI = Co-Investigator)

- **CERG grant of Hong Kong** (2006 ~ 2009), \$534k; PI.
- **RGC Central Allocation Collaborative Project** (2005~2008), \$3.48 million; CoI.
- **CERG grant of Hong Kong** (2004 ~ 2006), \$390k; PI.
- **CERG grant of Hong Kong** (2003 ~ 2006), \$565k; PI.
- **CERG grant of Hong Kong** (2003 ~ 2005), \$455k; CoI.
- **CERG grant of Hong Kong** (2002 ~ 2004), \$478k; PI.
- **NSFC/RGC Joint Research Project** (2002~2005), \$700k; CoI.
- **CERG grant of Hong Kong** (2001 ~ 2004), \$619k; PI.
- **CERG grant of Hong Kong** (2000 ~ 2002), \$467k; PI.
- **IGARD fund** (2000 ~ 2001), \$560k; PI.
- **President Special Fund for Corrosion Laboratory** (1999 ~ 2001), \$4.5m; PI.
- **6 PolyU Central Research Grants** (1999 ~ 2005), \$559k; PI;
- **1 PolyU Post-Dr Research Grant** (2002 ~ 2004), \$951k; CoI;
- **2 PolyU Inter-faculty Research Grant** (2003 ~ 2005), \$250k; CoI.

### Academic & Industrial Experiences

09/2005-now **Professor**, Department of Mechanical Engineering, The Hong Kong Polytechnic University

#### **Administrative Responsibilities at PolyU:**

- Deputy Programme Leader, BEng in Product Analysis with Design;
- Member of University Learning and Teaching Committee;
- Member of Faculty Board, Engineering Faculty;
- Chairman of Departmental Publicity Committee;
- Member of Departmental Management Committee;
- Timetabling Liaison Officer;
- Preferred Graduate Development Programme;
- Liaison Officer for Admission of Mainland Students;
- Officer in charge: Corrosion & Surface Technology Laboratory.

- 04/02-08/2005 **Associate Professor**, Department of Mechanical Engineering, The Hong Kong Polytechnic University
- 11/98-03/2002 **Assistant Professor**, Department of Mechanical Engineering, The Hong Kong Polytechnic University
- 01/92-11/98 **Research Scientist & Project Leader**, Materials and Mechanics Branch (92-96), Reactor Engineering Services Department (96-98), Atomic Energy of Canada Limited (AECL)
- Leader of a research team with an annual budget of CAD\$0.4 million, conduct theoretical and experimental studies on metal hydride cracking;
  - Leader of a task team on evaluating structural metal components in Canadian power plants;
  - Member of a joint task team which oversees R&D programs performed at several research centers for a total annual budget of CAD\$5 millions;
  - Analyst in theoretical and numerical simulations of stresses in metal structures, hydrogen diffusion, hydride formation and fracture under temperature and stress gradients.
- 12/84-08/86 **Junior Lecturer**, Department of Applied Physics, University of Science and Technology Beijing, China

#### Professional Activities

- **Editor-in-Chief** (2005-): Journal of Scanning Probe Microscopy, American Scientific Publishers;
- **Member of Advisory Board** (2004-2005), international journal “*Surface and Interface Analysis*”, John Wiley & Sons.
- **Founding Member** (2005), The Hong Kong Association of Computational Mechanics;
- **Member of Executive Committee** (2004-now), Hong Kong Society of Theoretical and Applied Mechanics;
- **Member of Organizing Committee** (2005~2006), 5th Asian-Australasian Conference on Composite Materials;
- **Session Chairman** (2005), the 18th International Conference on STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY (SMiRT 18);
- **Session Chairman** (2005, 2006), the Annual Conference of Hong Kong Theoretical and Applied Mechanics Society;
- **Member of Organizing Committee** (2004), The 3<sup>rd</sup> International Conference on Environmental Sensitive Cracking and Corrosion Damage;
- **Member of Organizing Committee & Session Chair** (2003), International Symposium on Macro-, Meso-, Micro-, and Nano-Mechanics of Materials (MM2003);
- **Advisory Member of Editorial Board** (2000-now) of *Journal of University of Science and Technology Beijing* (English Edition);
- **Adjunct Professor** (2000-2001), The Key Lab “Environmental Fracture”, University of Science and Technology Beijing;
- **Assessor** (1996 - 1998), United States NRC on metal hydride fracture mechanisms;
- **Invited External Advisor or Examiner**, Ph.D. thesis (1995 - 1998), Department of Chemical and Material Engineering, University of Alberta; PhD. thesis (2004), Department of Physics, Hong Kong University of Science and Technology; PhD thesis (2005), Department of Chemistry, University of Hong Kong; PhD thesis (2006), Department of Mechanical Engineering, Hong Kong University of Science and Technology; M.Phil thesis (2006), Department of Mechanical Engineering, University of Hong Kong;

- **Invited Peer Reviewer**, Mechanics of Materials, Journal of Nuclear Materials, Metallurgical Transaction, Scripta Metallurgica, the Proceedings of the 11<sup>th</sup> International Conference in Zirconium in Nuclear Industry;
- **External Supervisor**, Ph.D. candidates (1994 and 1995) from University of Manitoba, Canada; Ph.D. candidate (2003~2005) from Institute of Metal Research, Chinese Academy of Sciences; Ph.D. candidates (2002~2004) from University of Science and Technology Beijing;
- **Member**: The Metals, Minerals and Materials Society (USA); Materials Research Society (USA); Hong Kong Society of Theoretical and Applied Mechanics (HKSTAM); Hong Kong Association of Computational Mechanics
- **Session Chair** (1999), International Symposium on Mechanical Deformation of Materials under Extreme Conditions;
- **Co-opt Committee Member** (1999-2004), HKIE Nuclear Division.
- **Invited Talk** (1991) at Canadian Fusion Project Center: *Hydrogen Induced Helium Release in Ion Implanted Nickel*;
- **Invited Talk** (1991) at Atomic Energy of Canada Limited: *Hydrogen Induced Helium Release in Ion Implanted Nickel*;
- **Invited Talk** (1993) at Ontario Hydro Technology: *The Development of KIH Theory*;
- **Invited Talk** (1998) at Tsinghua University: *The Advances in the Theory of Delayed Hydride Cracking*;
- **Invited Talk** (2000) at HKIE: *CANDU<sup>TM</sup> – The Canadian Effort*;
- **Invited Talk** (2000) at International Workshop on Ultra High Speed Deformation, Hiroshima, Japan: *Interaction between Supersonic Dislocation and Subsonic Dislocation/Point Defect Clusters*;
- **Invited Talk** (2000) at HKUST: *Modeling of Defect Interaction and Hydrogen Storage Materials*.
- **Invited Plenary Talk** (June 2001) at 3<sup>rd</sup> International Conference on Materials Structure & Micromechanics of Fracture, Brno, Czech Republic: *Interactions between Transonic Dislocation and Defects*.
- **Invited Talk** (July 2001) at Dalian Maritime University, *Computer Modeling in Materials Science*.
- **Invited Talk** (July 2001) at Institute for Metal Research, Chinese Academy of Sciences, *Fracture of Carbon Nanotubes in Hydrogen Environment*.
- **Invited Talk** (December 2001) at The Key Lab “Environmental Fracture” of USTB: *Modeling of Phase Transformation*.
- **Invited Keynote Talk** (Oct 2001) at International Workshop “Nano-scale Materials Testing: Challenge & Approach”, Beijing, China, *Investigation of Mechanical Properties of Materials Using Nano-Indentation Technology*.
- **Included in “Who’s Who in the World”**, 19<sup>th</sup> edition, Marquis, 2002.
- **Included in “Who’s Who in Science and Engineering”**, 8<sup>th</sup> edition, Marquis, 2005~2006.
- **Invited Talk** (September 2002) at International Conference on Hydrogen Effects on Materials Behavior and Corrosion Deformation Interaction, *The Effect of Applied Stress on the Accommodation Energy and the Solvi for the Formation and Dissolution of Zirconium Hydride*, Jackson Lake Lodge, USA.
- **Invited Talk** (June 2004) at IUTAM Symposium on Size Effects on Material and Structural Behavior at Micron- and Nano-scales, *Size Effect in Carbon Nanotubes*, HKUST, China.
- **Invited Talk** (June 2004) at IUTAM Symposium on Size Effects on Material and Structural Behavior at Micron- and Nano-scales, *Size Effect in Surface Corrosion of Steel*, HKUST, China.

- **Invited Talk** (August 2004) at 3<sup>rd</sup> International Conference on Environment Sensitive Cracking and Corrosion Damage, *Prediction of Hydrogen Diffusion and Hydride Precipitation Processes at a Stress Concentrator in Zirconium*, Qing Dao, China.
- **Invited Talk** (May 2005) at the 8th International Conference on Applications of Diamond and Related Materials/1st NanoCarbon Joint Conference, *Formation of Junctions and Defects in Carbon Nanotubes*, Argonne National Laboratory, USA.

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**Patent:** "Methods for Manufacturing Metal Oxide Nanowires" by C.H. Xu, S.Q. Shi, Y. Liu and C.H. Woo was filed to US Patent and Trademark Office on September 2, 2005 (Application No. 11/217,483).

### **Peer Reviewed Publications**

K.K. Wong, S.Q. Shi and K.T. Lau, "[Mechanical and Thermal Behavior of a Polymer Composite Reinforced with Functionalized Carbon Nanotubes](#)", Key Engineering Materials, Vol. 334-335, pp.705~708, 2007.

Z. Yang and S.Q. Shi, "[Fabrication and tribological properties of polymer-carbon nanotubes nanocomposites](#)", Key Engineering Materials, Vol. 334-335, pp.661~664, 2007.

H. Y. Huang, W. Y. Chu, Y. J. Su, J. X. Li, L. J. Qiao and S.Q. Shi, "[Experiment and first principles investigation on the hydrogen-hindered phase transition of ferroelectric ceramics](#)", Applied Physics Letters, **89**, 142904, 2006.

DONG Kun , XU Jiu-Jun, CHENG Xiao-Yin, SHI San-Qiang, JI Yu-Long, LIN Bing-Feng, SUN Yu-Qing, "[Effect of Heat Treatment on the Erosive Properties of NiTi Shape Memory Alloys](#)", Tribology, Vol.26, No.5, pp.427~432, 2006. (in Chinese)

J.J. Xu, H.Y. Cheung and S.Q. Shi, "[Mechanical Properties of Titanium Hydrides](#)", accepted by Journal of Alloys and Compounds, 2006.

Z. Yang, Y. Huang, B. Dong, H.L. Li and S.Q. Shi, "[Densely Packed Single Crystal Bi<sub>2</sub>Fe<sub>4</sub>O<sub>9</sub> Nanowires from a Template Induced Sol-gel Route](#)", Journal of Solid State Chemistry, Vol. 179, pp.3324~3329, 2006.

Q. Tang, S.Q. Shi and L.M. Zhou, "[The Effect of Temperature and Relative Humidity on Patterning of A Ferroelectric Polymer P\(VDF-TrFE\) Via Dip-Pen Nanolithography](#)", International Journal of Nanoscience, Vol. 5, No. 1, pp.57~67, 2006.

Zhi Yang, Yi Huang, Bin Dong, Hu-Lin Li, and San-Qiang Shi, "[Sol-gel template synthesis and characterization of LaCoO<sub>3</sub> nanowires](#)", Applied Physics A, Vol. 84, 117~122, 2006.

C.H. Xu, S.Q. Shi, H.C. Man, C.H. Woo and C. Surya, "[Oxidation behavior of the TiNi shape memory alloy with a laser surface melted layer](#)", Journal of Materials Science, Vol.41, pp.1123~1129, 2006.

He Gong, Ming Zhang, Ling Qin, Lee Ka Ho Kenneth, Xia Guo, San-Qiang Shi, "[Regional Variations in Microstructural Properties of Vertebral Trabeculae with Structural Groups](#)", Spine, Vol. 31, No. 1, pp.24~32, 2006.

F.Y. Meng, S.Q. Shi, D.S. Xu, and C.T. Chan, ["Surface reconstructions and stability of X-shaped carbon nanotube junction"](#), Journal of Chemical Physics, Vol. 124, No. 2, Art. No. 024711, 2006.

X.Q. Ma, S.Q. Shi, C.H. Woo and L.Q. Chen, ["The phase field model for hydrogen diffusion and  \$\gamma\$ -hydride precipitation in zirconium under non-uniformly applied stress"](#), Mechanics of Materials, Vol. 38, issues 1-2, pp.3~10, 2006.

Qin L, Fok PK, Lu HB, Shi SQ, Yang L, Leung KS, ["Low Intensity Pulsed Ultrasound improves the material properties of the healing tissues at bone-tendon insertion - a partial patellectomy model in rabbits"](#), Clinical Biomechanics, Vol. 21, pp.387~394, 2006.

F.Y. Meng, S.Q. Shi, D.S. Xu, and R. Yang, ["Size effect of X-shaped carbon nanotube junctions"](#), Carbon, Vol.44 (7), pp.1263~1266, 2006.

F.Y. Meng, S.Q. Shi, D.S. Xu, and C.T. Chan, ["Mechanical properties of ultrathin carbon nanotube junctions"](#), Modeling and Simulation in Materials Science and Engineering, Vol. 14, No. 5, S1-S8, July, 2006.

X.H. Guo, S.Q. Shi and X.Q. Ma, ["Elastoplastic phase field model for microstructure evolution"](#), Applied Physics Letters, Vol. 87, Art. No. 221910, 2005.

S.Q. Shi, X.Q. Ma, X.N. Jing, X.H. Guo, L.Q. Chen, ["PHASE FIELD SIMULATION OF HYDROGEN DIFFUSION AND HYDRIDE FORMATION PATTERN IN ZIRCONIUM"](#), in Structural Mechanics in Reactor Technology, edited by Yu Zhou, et al., Atomic Energy Press, 2005, pp.186~197, (ISBN 7-5022-3421-7).

Q. Tang, S.Q. Shi and L.M. Zhou, ["Effect of Surface Roughness on Dip-pen Nanolithography"](#), Journal of Nanoscience and Nanotechnology, Vol. 5, No. 12, pp.2173~2187, 2005.

X.Q. Ma, S.Q. Shi, S.Y. Hu, C.H. Woo and L.Q. Chen, ["Modeling of Hydrogen Diffusion Process at a Blunt Notch in Zirconium"](#), Journal of University of Science and Technology Beijing (English edition), Vol.12, No. 5, pp.416~421, 2005.

Q. Tang, S.Q. Shi and L.M. Zhou, an invited book chapter *"Nanostructures of Polymer Constructed via Atomic Force Microscopy and Their Applications"* published in *"Polymeric Nanostructures and Their Applications"*, edited by H.S. Nalwa, American Scientific Publishers, December, 2005.

Chi-kin Poon, Li-min Zhou, Wei Jin and San-qiang Shi, ["Interfacial debond of shape memory alloy composites"](#), Smart Mater. Struct. 14, pp.N29-N37, 2005.

Q. Tang, S.Q. Shi, L.M. Zhou and C.H. Xu, ["Comparative Study of Fabrication Patterns of a Ferroelectric Polymer P\(VDF-TrFE\) on Gold Thin Film and Gold Ball via Dip-pen Nanolithography"](#), Nanotech 2005, Cambridge, MA: Nano Science & Technology Institute, Vol. 2, pp. 711~714, 2005.

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C.H. Xu, S.Q. Shi and Q. Tang, "[Synthesis of Antimony Oxide Nanoparticles by Thermal Oxidation](#)", Nanotech 2005, Cambridge, MA: Nano Science & Technology Institute, Vol. 2, pp. 54~57, 2005.

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S.G. Lu, Haydn Chen, C.L. Mak, K.H. Wong, H.L.W. Chan, C.L. Choy, J.J. Xu and S.Q. Shi, "[Preparation and Characterization of Compositionally Graded Epitaxial Barium Strontium Titanate Thin Films via Scanning Probe Microscopy](#)", Key Engineering Materials, Vols. 280~283, pp.1903~1908, 2005.

C.H. Xu, C.H. Woo and S.Q. Shi, "[Formation of CuO Nanowires on Cu Foil](#)", Chemical Physics Letters, Vol. 399, pp.62~66, 2004.

F.Y. Meng, S.Q. Shi, D.S. Xu, R. Yang, "[Multiterminal junctions formed by heating ultrathin single-walled carbon nanotubes](#)", Physical Review B, Vol. 70, 125418, 2004.

Q. Tang, S.Q. Shi and L.M. Zhou, a review article "[Nanofabrication with Atomic Force Microscopy](#)", Journal of Nanoscience and Nanotechnology, Vol. 4, No. 8, pp.948~963, 2004.

C.H. Xu, C.H. Woo and S.Q. Shi, "[The Effects of Oxidative Environment on Synthesis of CuO Nanowires on Cu Substrate](#)", Superlattices and Microstructures, Vol. 36, pp.31~38, 2004.

Q. Tang, C.H. Xu, S.Q. Shi and L.M. Zhou, "[Formation and Characterization of Protein Patterns on the Surfaces with Different Properties](#)", Synthetic Metals, Vol. 147, pp.247~252, 2004.

C.H. Xu, C.H. Woo, S.Q. Shi, Y. Wang, "[The Effects of Frequencies of AC Modulation Voltage on Piezoelectric-induced Images Using Atomic Force Microscopy](#)", Materials Characterization, Vol. 52, pp.319~322, 2004.

Q. Tang, S.Q. Shi, H.T. Huang and L.M. Zhou, "[Fabrication of highly oriented micro- and nanostructures of ferroelectric P\(VDF-TrFE\) copolymer via dip-pen nanolithography](#)", Superlattices and Microstructures, Vol. 36, pp.21~29, 2004.

C.H. Xu, S.Q. Shi, C.H. Woo and Y. Wang, "[Behavior of a movable electrode in piezo-response mode of an atomic force microscope](#)", Journal of Applied Physics, Vol. 95, pp.8431~8435, 2004.

C.H. Xu, X.Q. Ma, S.Q. Shi, C.H. Woo, "[Oxidation behavior of TiNi shape memory alloy at 450~750°C](#)", Materials Science and Engineering A, Vol. 371, pp.45~50, 2004.

J.J. Xu and S.Q. Shi, "[Investigation of mechanical properties of  \$\epsilon\$ -zirconium hydride using micro- and nano-indentation techniques](#)", Journal of Nuclear Materials, Vol. 327/2-3, pp.165~170, 2004.

Jie Wang, San-Qiang Shi, Long-Qing Chen, Yulan Li, Tong-Yi Zhang, "[Phase field simulations of ferroelectric/ferroelastic polarization switching](#)", Acta Materialia, Vol. 52, pp.749~764, 2004.

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A.W. Thompson, R. Ricker, G. Was, and R. Jones, TMS, 2004, pp. 233-248. (ISBN: 0-87339-501-8)

X.Q. Ma, S.Q. Shi, C.H. Woo and L.Q. Chen, “*Modeling of hydrogen diffusion and  $\gamma$ -hydride precipitation process at a blunt notch in zirconium*”, in “Computational Methods in Engineering and Science”, edited by V.P. Lu, L.N. Lamas, Y-P Li and K.M. Mok, Swets & Zeitlinger B.V., Lisse, The Netherlands, 2003, pp.939~946. (ISBN 90 5809 567 3)

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### **Recent Peer Reviewed Conference Papers**

X.H. Guo, S.Q. Shi and L.J. Qiao, at the 2<sup>nd</sup> Jiangsu-Hong Kong Forum on Mechanics and Its Applications, "Simulation of hydrogen-induced cracking in PZT ferroelectric ceramics using a phase field model", May 27~28, Nanjing, China, 2006.

F.Y. Meng, S.Q. Shi, D.S. Xu, C.T. Chan, at HKSTAM Annual Conference/3<sup>rd</sup> Shanghai - Hong Kong Forum on Mechanics and Its Application, "Topological Structure and Properties of Ultrathin Carbon Nanotube Junctions", March 11, 2006, Hong Kong, pp.30.

F.Y. Meng, S.Q. Shi, D.S. Xu, C.T. Chan, at International Anniversary Symposium on Molecular Dynamics Simulations, "Mechanical Properties of Carbon Nanotubes Junctions", Osaka, Japan, August 29-30, 2005, pp.s1~s8.

S.Q. Shi, X.Q. Ma, X.N. Jing, X.H. Guo, L.Q. Chen, at the 18th International Conference on STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, PHASE FIELD SIMULATION OF HYDROGEN DIFFUSION AND HYDRIDE FORMATION PATTERN IN ZIRCONIUM, August 7~12, 2005, Beijing, in CDROM.

S.Q. Shi, at the 2nd Shanghai - Hong Kong Forum on Mechanics and Its Application, *An Elastoplastic Phase Field Model for Microstructure Evolution*, June 25, 2005, Shanghai, p.18.

S.Q. Shi, F.Y. Meng, L.G. Zhou and R. Yang, invited talk at the 8th International Conference on Applications of Diamond and Related Materials/1st NanoCarbon Joint Conference, "Formation of Junctions and Defects in Carbon Nanotubes", Argonne National Laboratory, May 15-19, 2005, USA, section 5.

X.H. Guo and S.Q. Shi, at HKSTAM Annual Conference, *An New Elastoplastic Phase Field Model for Microstructure Evolution near Voids and Cracks*, March 12, 2005, Hong Kong, pp.7.

S.Q. Shi and X.Q. Ma, invited at 3<sup>rd</sup> International Conference on Environment Sensitive Cracking and Corrosion Damage, *Prediction of Hydrogen Diffusion and Hydride Precipitation Processes at a Stress Concentrator in Zirconium*, August 2004, Qing Dao, China, p.27~31.

H. Gong, M. Zhang, H.Y. Yeung, L. Qin, X. Guo and S.Q. Shi, at BME2004 Biomedical Engineering Conference, *Microstructural properties of vertebral trabeculae in different structure model groups*, 23-25 Sept, 2004, Hong Kong, pp.59-61.

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S.Q. Shi, F.Y. Meng, R. Yang, invited at IUTAM Symposium on Size Effects on Material and Structural Behavior at Micron- and Nano-scales, *Size Effect in Carbon Nanotubes*, May 30 ~ June 4, 2004, HKUST, China.

S.Q. Shi, Y. Yuan, L.J. Qiao, invited at IUTAM Symposium on Size Effects on Material and Structural Behavior at Micron- and Nano-scales, *Size Effect in Surface Corrosion of Steel*, May 30 ~ June 4, 2004, HKUST, China, p.30.

X.Q. Ma, S.Q. Shi, C.H. Woo and L.Q. Chen, at International Symposium on Macro-, Meso-, Micro-, and Nano-Mechanics of Materials (MM2003), *The Phase Field Model for Hydrogen Diffusion and  $\gamma$ -hydride Precipitation in Zirconium Under Non-Uniformly Applied Stress*, December 8 ~ 10, 2003, HKUST, p.201~202.

F.Y. Meng, L.G. Zhou, S.Q. Shi and R. Yang, at The 2003 Seventh International Conference on the Application of Diamond Films and Related Materials and Third International Conference on Frontier Carbon Technology (ADC/FCT2003), *INTERACTION BETWEEN CATALYST METALS AND STONE-WALES DEFECTS IN CARBON NANOTUBES*, August 18 - 21, 2003, Tsukuba, Japan, Proceedings, p.65~69.

L.G. Zhou, F.Y. Meng and S.Q. Shi, at 2003 NanoTech Conference, *Effects of Stone-Wales Defect on Adsorption & Insertion Capacity of Nanotubes*, San Francisco, California, U.S.A., February 23~27, 2003.

J.J. Xu, X.Q. Ma, S.Q. Shi and M.P. Puls, at The 13<sup>th</sup> Pacific Basin Nuclear Conference, *Investigation of Mechanical Properties of Zirconium Hydride Using Micro- and Nano-indentation Techniques*, Shenzhen, China, Oct 21~25, 2002, pp.1014~1021.

M.P. Puls, B.W. Leitch, S.-Q. Shi, invited talk at International Conference on Hydrogen Effects on Materials Behavior and Corrosion Deformation Interaction, *The Effect of Applied Stress on the Accommodation Energy and the Solvi for the Formation and Dissolution of Zirconium Hydride*, Jackson Lake Lodge, USA, 22-26 September 2002.

K.T. LAU and S.Q. SHI, at European-MRS 2002 Spring Conference, *Flexural Behaviour and Hardness of Nanotube Composites*, Strasburg, France, 18-21 June 2002.

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L.G. Zhou and S.Q. Shi, at the 10<sup>th</sup> International Conference of Fracture, *Detrimental Effect of Hydrogen on The Fracture Strength of Single- and Multi-Walled Carbon Nanotubes*, Hawaii, USA, December 2001.

X.Q. Ma, S.Q. Shi, L.Q. Chen and C.H. Woo, at Materials Research Society Spring Conference, *Computer Simulation of Hydride Precipitation in Bi-crystalline Zirconium*, San Francisco, USA, April 2001, pp.AA4.14.1~5.

S.Q. Shi, W.J. Zhu, C.H. Woo and H. Huang, invited plenary talk at 3<sup>rd</sup> International Conference on Materials Structure & Micromechanics of Fracture, Brno, Czech Republic: *Interactions between Transonic Dislocation and Defects*, June 2001, pp.84~99.

S.Q. Shi and L.G. Zhou, Joint Diamond and Carbon Conferences, *The Fracture Strength of Carbon Nanotubes in Hydrogen Environment*, Auburn, USA, August 5 ~ 12, 2001, pp.773~778.

S.J. Liu, S.Q. Shi, H. Huang, and C.H. Woo, at International Union of Materials Research Societies Conference, *Ab initio Pair Potentials and Mechanical Properties of Zirconium Hydrides*, Hong Kong, China, July, 2000, pp.B3.23.

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S.Q. Shi, H. Huang and C.H. Woo, invited talk at International Workshop on Ultra High Speed Deformation, *Interaction between High Speed Dislocations and Other Defects*, Hiroshima, Japan, August, 2000.

#### **A Selection of Non-Refereed Reports**

S.-Q. Shi, "*Safety Assessment of A Type of Subsurface Flaws Found in Bruce Unit 6 Fuel Channel K01*", AECL Report, September, 1998.

S.-Q. Shi, "*Assessment of Flaws Found in Point Lepreau NGS Fuel Channels During the 1997 Inspection*", AECL Report, January, 1998.

S.-Q. Shi, "*On the Deuterium Depletion Zone near Pressure Tube Inside Surfaces*", AECL Report, December, 1997.

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S.-Q. Shi, A.M. Stadnyk and B.W. Leitch, "*Hydride Fracture Stress in Zr-2.5Nb*", AECL Report, 1994.

S.-Q. Shi, "*Approximate Error Analysis for Delayed Hydride Cracking Experiments*", AECL Report, 1994.

S.-Q. Shi, "*MAXER 2.1: A PC Code to Determine the Potential for DHC Initiation at Blunt Notches in Zirconium Alloys*", AECL Technical Notes, 1993.

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### **Research Personnel**

Dr. Zhou Longguang, research fellow (2006)

Dr. Yang Zhi, research associate (2005~2006)

Mr. Lester Ka Keung Wong, MPhil student (2005~2007)

Dr. Meng Fanyan, research associate (2005~2006)

Dr. Xu Chunhua, research fellow (2005)

Dr. Tang Qian, research associate (2005~2006)

Dr. Guo Xianghua, research associate (2004~2006)

Dr. Xu Chunhua, research associate (2004 ~ 2005)

Ms. Tang Qian, PhD student (2002 ~ 2005)

Dr. Ma Xingqiao, research associate (2004)

Ms. He Jian Ying, visiting scholar from USTB (2004)

Mr. Zhu Shengli, visiting scholar from Tianjin University (2004)

Mr. Shan Guangbin, visiting scholar from USTB (2004)

Dr. Xu Shi-Min, research associate (2004)

Dr. Xu JiuJun, research associate (2004), current address: Dalian Maritime University.

Dr. Jing Xiaoning, research associate (2003~2004), current address: MTU, USA

Dr. Wang Chao, research associate (2003~2004)

Mr. Yao Yuan, PhD candidate, research assistant (2003 ~ 2004)

Dr. Xu Chunhua, Post-Dr fellow (2002 ~ 2005)

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Mr. Li Dingyi, senior consultant (1999)

Mr. Zhou Longguang, research assistant, PhD candidate (2000 ~ 2001)

Mr. Tsang Kam Ming, full-time/part-time student assistant (2001)

Mr. Lam Man Hung (Ken), full-time student assistant (2000)

Mr. Wong S.K. (Jimmy), part-time student assistant (2000 ~ 2001)

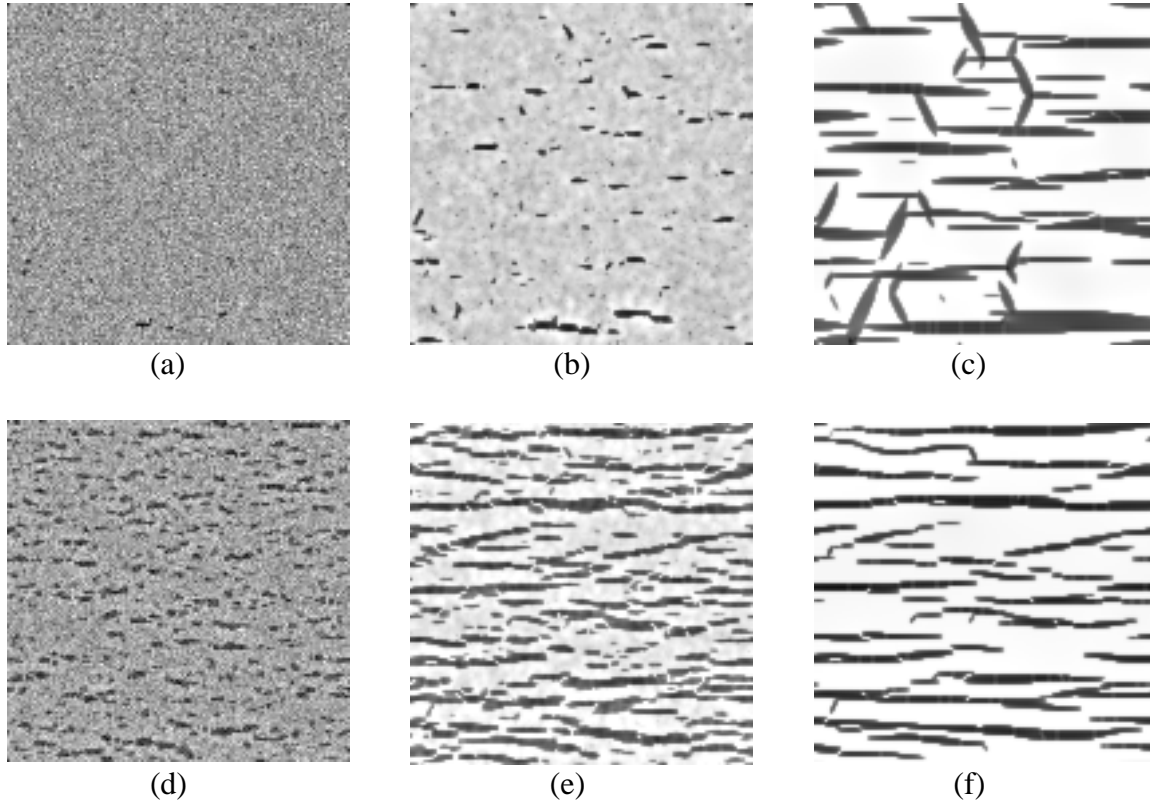
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### **Opening Positions**

One research assistant/associate position or one PhD studentship is available in the area of phase field simulation of materials. The candidate should have a strong research/educational background in theoretical mechanics of materials (especially in plasticity and fracture). A good knowledge in phase transformation of materials, non-linear partial differential equations and numerical modeling using Fortran programming would be asset.

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Computer simulation of  $\gamma$ -hydride precipitation under external stress applied vertically.  $[1\bar{1}\bar{2}0]$  direction of the matrix is along horizontal axis,  $128 \times 128$  uniform grid.

(a)  $t^*=500$ , (b)  $t^*=1000$ , and (c)  $t^*=5000$  at low external tensile stress.

(d)  $t^*=500$ , (e)  $t^*=1000$ , and (f)  $t^*=5000$  at high external tensile stress.

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