

## **WEI GAO**

BE, (*Northeastern Univ*), ME, (*BCRI*), D.Phil. (*Oxford*), Fellow of Royal Society NZ, Fellow of Institution of Professional Engineers NZ, Member of MRS, TMS, SMNZI and ACA

---

### **PRESENT POSITION**

Professor, Chemical and Materials Engineering Department.  
Associate Dean International, School of Engineering.  
Coordinator, Materials and Nano-Technology Research Cluster/Centre.  
Associate Director, China Studies Centre, the University of Auckland

### **AWARDS AND PREVIOUS POSITIONS**

R J Scott Medal, Royal Society of New Zealand (2001).  
Visiting Professor, Hong Kong University (2002).  
Visiting Professor, National University of Singapore (1998).  
Principal Research Investigator, Director of Rapid Solidification Laboratory, Massachusetts Institute of Technology (MIT), USA. (1991-1992), Postdoctoral Research Associate, Department of Materials Science and Engineering, Massachusetts Institute of Technology (MIT), USA. (1988-1990).  
SERC (UK) Research Fellowship, Department of Metallurgy and Science of Materials, Oxford University, U.K., (1987-1988).  
University Lecturer, Department of Metallic Materials, Chengdu University of Science and Technology, China, (1982-1985).  
Metallurgical Engineer and Technical Director of the Electric Arc Furnace and Casting Workshop, Chengdu Steel, China, (1971-1978).

### **PROFESSIONAL AFFILIATIONS**

Fellow of Royal Society of New Zealand (FRSNZ)  
Fellow of Institution of Professional Engineers New Zealand (FIPENZ)  
Secretary and Committee Member, the Society of Materials New Zealand  
Member of Australasian Corrosion Association (ACA)  
Member of Materials Research Society (MRS), USA  
Member of American Materials Society (TMS)  
Member of Materials Information Society USA  
Member of Metallurgical Society and Mechanical Engineers' Society China

### **OTHER POSITIONS**

Member of Management Committee New Zealand Asia Institute  
Honorary Professor, University of Science and Technology Beijing, China  
Concurrent Professor and PhD Supervisory Professor, Northeastern University, China  
Advisory Professor, South China University of Technology, China  
Advisory Professor, Gansu University of Technology, China  
Honorary Professor, Wuhan University of Chemical Technology, China  
Editor, Materials Transaction, Japan Institute of Materials  
Editorial Board, Key Engineering Materials  
Editorial Committee Journal of High Temperature Materials and Processes  
Editorial Committee, Journal of Materials Protection  
Fellow of APC NZ  
Committee Member NZCSA  
Board of Trustees, Birkenhead College, Auckland, New Zealand

### **TEACHING ACTIVITIES**

Electrical and Electronic Materials/Solid State Materials  
Materials Performance, Corrosion and Oxidation  
Nano-Structured Materials and Technologies  
Surface Engineering  
Superconducting Materials  
Ceramic Materials, Electronic Ceramics  
Advanced Materials and Processing  
Advanced Materials Characterisation  
Topics in Metallurgy, Materials Science and Engineering  
Materials and Society

### **RESEARCH ACTIVITIES**

#### **Nano-Structured Materials and Coatings:**

Nano-structure possesses special properties that the materials with ordinary structure do not have. For instance, the high density of grain boundaries in nano-coatings provides fast diffusion paths for selective formation of certain oxide scales, resulting in superior oxidation resistance. Many other physical properties are also very different when the structure goes to the nano-level. Our work has focused on processing, microstructure and property optimisation of nano-structured materials and coatings. Surface nano- and micro-crystallisation is also studied. This is a truly science frontier research with tremendous application potential.

#### **High Temperature Oxidation and Corrosion:**

High temperature corrosion and high temperature materials are our long-time research strength. The studies cover basic oxidation theories such as selective oxidation mechanisms, transition of internal and external oxidation, early stage oxide nucleation and growth, and P-B ratio for alloys. A number of novel testing and protection techniques have been developed in collaboration with University of

Science and Technology Beijing, including the ultra-low oxygen partial pressure reactor and electro-spark alloy-oxide coatings. The study also concentrated on applied aspects. For example, Ti-Al based composites and composite coatings were developed (with Waikato University), which can increase the application temperature of Ti alloys by 200-250° C.

#### **Electronic Materials and High Temperature Superconductors:**

One third of our group focuses on electronic materials. Projects include transparent-conductive oxide films such as ZnO thin films, dielectric materials and films, and micro-piezoelectric tubes. Novel or special processes were designed to produce these materials, including unbalanced magnetron sputtering and electrophoretic deposition. Our research targets several electronic device applications. The research on superconductors is concentrated on microstructure control of Bi-Sr-Ca-Cu-O compounds. High quality journal papers and patents represent our research outcomes.

The group currently has 3 Postdoctoral Fellows, 5 PhD students and 8 ME students, with very active international collaborations. Other research topics include Electrochemical Corrosion and Protection, Electroless Coating, Mg Welding and Protection Technologies (with AUT), Bio-Implanting and Dentistry Materials, Nano-Clay Reinforced Polymer Composites, Fe-Al, Ni-Al and Ti-Al Intermetallic Compounds, Rapid Solidification and Amorphous Alloys, Electron Microscopy and Microanalysis, Thermal Analysis, and Computer Modeling of Metallurgical Processes.

#### **RESEARCH SPONSORS:**

Royal Society of New Zealand (Marsden Fund)  
NZ Foundation for Research, Science and Technology (FRST)  
Lottery Sciences of New Zealand  
Asia 2000 Foundation of New Zealand  
International STC Agreement Collaboration (ISAC)  
Australian Institute of Nuclear Science and Engineering  
Institute for Materials Technology and Manufacturing, The University of Wollongong, Australia  
New Zealand Institute for Industrial Research Limited (IRL)  
New Zealand Heavy Engineering Research Association (HERA)  
New Zealand Industries including BHP New Zealand Steel, Fisher & Paykel Appliances, Argent Metal Technology Ltd., Electricity Corporation of New Zealand, Siemens New Zealand Ltd., Titanox Ltd., Fisher & Paykel HealthCare, Kiwi Dairy Ltd., Golden Bay Cement, Resource Refineries, Metal Protection Ltd., Blue Bird Food Ltd., and MasTip Ltd. etc.  
Auckland University Research Council (AURC)  
Auckland UniServices Ltd.

#### **RESEARCH COLLABORATIONS**

New Zealand Institute for Industrial Research Limited/Materials Performance Tech. Ltd.

New Zealand Industries

University of Waikato (NZ)

University of Canterbury (NZ)

Auckland University of Technology (NZ)

Oak Ridge National Laboratory, USA

Massachusetts Institute of Technology (MIT), USA

University of Science and Technology Beijing, China

National University of Singapore

Nanyang Technological University, Singapore

Institute of Corrosion and Protection of Metals, Chinese Academy of Sciences

Gansu University of Technology, China

Institute for Materials in Energy Systems, Julich Research Centre, Germany

Joint Research Centre, European Community

Institute for Superconducting and Electronic Materials, The University of Wollongong, Australia

Australian Institute of Nuclear Science and Engineering (AINSE)

Tokushima University, Japan

Yokohama University, Japan

Yonsei University, Korea

Korea Institute of Energy Research, Korea

Ames Lab, US Dept of Energy, Iowa State University, USA

## **PATENTS AND PUBLICATIONS**

7 US and International Patents, 3 MIT disclosures, 4 books and 380 refereed publications (180 refereed papers in journals), 18 Keynote/Invited Lectures in International Conferences.

18 Keynote and Invited Lectures in International Conferences

## **SELECTED (RECENT) PUBLICATIONS:**

### **Nano-Crystal Coatings, Oxidation and Corrosion:**

W. Gao, Z. Liu and Z. Li, "Nano- and Micro-crystal Coatings and their High-Temperature Applications", *Advanced Materials*, 13, No.13, 2001, 1001

W. Gao, Z. Li and D. Zhang, "New High-Temp, Oxidation-Resistant Ti-Based Materials", *Oxidation of Metals*, 57, 2002, 99-114

Z. Li, W. Gao, D. Ying and D. Zhang, "Improved oxidation resistance of Ti with a thermal sprayed Ti<sub>3</sub>Al(O) Al<sub>2</sub>O<sub>3</sub> composite coating", *Scripta Materialia*, 48-12 (2003) 1649-1653

Z. Li, W. Gao, M. Yoshihara and Y. He, "Improving Oxidation Resistance of Ti<sub>3</sub>Al and TiAl Intermetallic Compounds with Electro-Spark Deposit Coatings", *Materials Science and Engineering A247*, (2003) 243-252

Z. Li, W. Gao, J. Liang and D. Zhang, "Oxidation Behaviour of SiC and TiC Particulate Reinforced Ti<sub>3</sub>Al Intermetallic Matrix Composites", *International Journal of Modern Physics B*, Vol. 17, No. 8 & 9, (2003) 1770-1777

J. Lee, W. Gao and M. Hodgson, "Surface Study of Ti<sub>3</sub>Al, Ti<sub>3</sub>Al-11Nb, TiAl and TiAl-2Cr by XPS", *International Journal of Modern Physics B*, Vol. 17, No. 8 & 9, (2003) 1711-1717

Z. Li, W. Gao, J. Liang and D. Zhang, "Oxidation behaviour of Ti<sub>3</sub>Al - TiC composites", *Materials Letters*, 57 (2003) 1970-1976

K. Zhang, Z. Li and W. Gao, "Hot Corrosion Behaviour of Ti-Al Based Intermetallics", *Materials Letters*, 57 (2002) 834-843

W. Gao, Z. Li and Y. He, "High Temperature Resistant Coatings Produced by Electro-Spark Deposition", *Materials Science Forum*, Vols. 369-372, 2001, 579-586

C-H. Xu, W. Gao et al, "Characterisation of High Temperature Corrosion Products on FeAl Intermetallics by XPS", *Corrosion Science*, 43, 2001, 1891-1903

Z. Li, W. Gao et al, "Oxidation Behaviour of a Ti<sub>3</sub>Al-Nb Alloy with Surface Thin Oxide Films", *Oxidation of Metals*, 56, Nos.5/6, 2001, 495-516

C-H. Xu, W. Gao and S. Li, "Oxidation Behaviour of FeAl Intermetallics - The Effects of Y on the Scale Spallation Resistance", *Corrosion Science*, 43, 2001, 671-688

C. Xu and W. Gao, "Oxidation Behaviour of FeAl Intermetallics, Effects of Reactive Elements on Cyclic Oxidation Properties", *Materials Science and Technology*, 17(3), 2001, 324-332

W. Gao, "High-temperature Corrosion Research at the University of Auckland, New Zealand", *Corrosion Engineering Japan*, 49(10), 2000, 592

Z. Liu and W. Gao, "Effects of Cr on the Oxidation Performance of b-FeAl-Cr Coatings", *Oxidation of Metals*, 54, ¼, 2000, 189-209

J. Noh, N. Laycock, W. Gao and B. Wells "Effects of nitric acid passivation on the pitting resistance of 316 stainless steel", *Corrosion Science*, 42, 12, 2000, 2069-2084

Z. Liu and W. Gao, "Oxidation Behaviour of Cast Ni<sub>3</sub>Al Alloys and Micro-Crystalline Ni<sub>3</sub>Al+5%Cr Coatings with and without Y-Doping", *Oxidation of Metals*, 1/2000

Z. Li, Y. He and W. Gao, "An Ultra-Low Oxygen Partial Pressure Controlling System and its Application to Oxidation Studies", *Oxidation of Metals*, 54, 1, 2000, 47-62

Z. Li, Y. He and W. Gao, "Use of a Solid-State Oxygen Pump to Study Oxidation Kinetics of Cr and Mo", *Oxidation of Metals*, 53, 5 (2000) 577-596

C-H. Xu and W. Gao, 'Oxidation Behaviours of FeAl Intermetallics - The Effect of Y on the Scale Spallation Resistance', *Intermetallics*, 8(7) (2000) 769-779

Z. Liu, W. Gao and Y. He, "Modelling of Oxidation Kinetics of Y-Doped Fe-Cr-Al Alloys", *Oxidation of Metals*, Vol.53 No.3/4, (2000) 341-351

C-H. Xu and W. Gao, "Pilling-Bedworth Ratio for Oxidation of Alloys", *Materials Research Innovations*, Vol.3, No. 4, (2000) 231-235

M. Li, W. Gao and Z. Liu; "Determination of oxide growth stress by a novel deflection method", *Oxidation of Metals*, vol. 51, no. 5-6, pp. 333-351, June 1999

Z. Liu, W. Gao and Y. He, "Oxidation Behaviour of Nanocrystalline Fe-Ni-Cr-Al Alloy Coatings", *Materials Science and Technology*, 15(12), (1999) 1147-1150

- Z. Liu, W. Gao and M. Li, "Cyclic Oxidation of Sputter Deposited Nano-Crystalline Fe-Cr-Ni-Al Alloy Coatings", *Oxidation of Metals*, Vol. 51 No. 5/6, (1999) 403-419
- Z. Liu, W. Gao, K. Dahm, and F. Wang, "Improved Oxide Spallation Resistance of Micro-crystalline Ni-Cr-Al Coatings", *Oxidation of Metals*, Vol. 50, Nos ½ (1998) 51-69
- Z. Liu, W. Gao, K. Dahm, and F. Wang, "Oxidation Behaviour of Sputter-Deposited Ni-Cr-Al Micro-Crystalline Coatings", *Acta Metallurgica and Materialia*, 46(1998) 1691-1700
- Z. Liu and W. Gao, "A Numerical Model to Predict the Kinetics of Anisothermal Oxidation of Metals", *High Temperature Materials and Processes*, 17 (1998) 231-236
- Z. Liu, W. Gao, and Y. He, "Surface Nano-Crystallisation of 310s Stainless Steel and Its Effect on the Oxidation Behaviour", *Journal of Materials Engineering and Performance*, 7 (1998) 88-92
- Y. He, Z. Li, H. Qi, and W. Gao, (1998), Diagrams of the Standard Free Energy of Formation of Oxide, Sulphide, Carbide and Nitride Per Unit Volume, *Materials Research Innovations*, 1, 157

#### **Superconductors and Electronic Materials:**

- W. Gao, Z. Li, R. Harikisun and S-S. Chang, "Zinc Oxide Films Formed by Oxidation of Zinc under Low Partial Pressure of Oxygen", *Materials Letters*, 57 (2003) 1435-1440
- J. Yoo and W. Gao, "Near-Net Ceramic Micro-Tubes Fabricated by Electrophoretic Deposition", *International Journal of Modern Physics B*, Vol. 17, No. 8 & 9, (2003) 1147-1152
- W. Gao, H. Gong, J. He et al, "Oxidation Behaviour of Cu Thin Films on Si Wafer at 175-400° C", *Materials Letters*, 51 (2001) 78-84
- S. Li, W. Gao and H. Cooper, "The Effect of Mechanical Deformation on the Phase Transformation of BSCCO Superconductors", *Physica C* 356 (3), 2001, 197-204
- T. Tan, S. Li, H Cooper, W. Gao, H.K. Liu and S.X. Dou, "Characteristics of Microtexture and Mesotexture in (Bi,Pb)2Sr2Ca2Cu3O10 Superconductor Tapes", *Superconductor Science and Technology*, 14 (7), 2001, 471-479
- B. Rong, R. Cheung, W. Gao, M. Alkaisi and R. Reeves, "Effects of Reactive Ion Etching on the Electrical Characteristics of GaN", *J. Vac. Sci. Technol.*, B 18(6), 2000, 3467-3470
- S-S. Chang and W. Gao, "Luminescence Properties of Spark-Processed GaP", *Materials Science and Engineering B85*, 2001, 1-5
- H. Cooper, W. Gao, S. Li, H. Liu and S. Dou, "Phase Transformation Characteristics of BSCCO Tapes Processed Via Cryogenic and Room Temperature Pressing", *Superconductor Science and Technology*, 14, 2001, 533-538
- S. Li, W. Gao, H. Liu, T. Chandra and S. Dou, "Texturing and Grain Growth Behaviour of Bi2223 Superconducting Oxide During Annealing", *Physica C*, 302(1998) 311-308
- S. Li, W. Gao, Q. Hu, H. Liu and S. Dou, "The Fracture Behaviour of Bi2223 Superconductor Polycrystals Clad with Silver Sheets", *Physica C* 295(1998) 64-74

R. Cheung, J. Hay, V-D. Drift, W. Gao, "Improvement of Contact Resistances on Plasma-exposed Silicon Carbide", *Solid-State Electronic*, 44(11), 2000, 2081-2083

J. Yoo, W. Gao and K. Yoon, "Pyroelectric and Dielectric Bolometer Properties of Sr Modified BaTiO<sub>3</sub> Ceramics", *Journal of Materials Science*, 34 (1999) 5361-5369

B. Rong, R. Cheung, W Gao, and M. Kamp, "Fabrication of Nanostructures in GaN", *Microelectronic Engineering*, 53(1-4), 2000, 419-422

S. Li, W. Gao, Q. Hu and S Dou, (1997), The Grain Alignment of Bi<sub>2</sub>223, Bi<sub>2</sub>212 and Bi<sub>2</sub>223+Bi<sub>2</sub>212 Phases in Mechanical Deformation and Annealing Processes, *Physica C*, 279, 265-276

Gao W. and Vander Sande, J.B., (1992), Textured BSCCO/Ag Superconducting Microcomposites with Improved Critical Current Density through Mechanical Deformation, *Superconductor Science and Technology*, 5, 318-326.

Gao W. and Vander Sande, J.B., (1991), Increasing the Critical Current Density of BSCCO/Ag Superconducting Microcomposites by Mechanical Deformation, *Physica C*, 181, 105-120

#### **Books and Others:**

W Gao and N Sammes, "Introduction to Electronic and Ionic Materials", published by World's Scientific Publisher, Singapore/New Jersey, London, Hong Kong, 5/1999, 357 pages

Sean Li and Wei Gao, "Effects of Mechanical Deformation and Thermal Treatment on Microstructure of BSCCO Superconductors" in "Studies of High Temperature Superconductors" vol. 43, Anant Narlikar ed., Nova Science Publishers, New York, 1 - 43 (2002).

WG Ferguson and W Gao (Editors), "Advanced Materials Development and Performance" (Conference Proceedings), CCE, ISBN 0 86869 068 6, 1997 (512 pages)

W Gao and J B Vander Sande, "Metallic Precursor Method to Electronic Materials", in "Encyclopaedia of Advanced Materials", Bloor, Brook, Flemings and Mahajan eds., Elsevier Science Ltd (1994) pp1560

C. Xu, W. Gao and Y. Yang, "Superplastic Boronising of Low Alloy Steel - Microstructural Aspects", *J. Materials Processing Technology*, 108, 2001, 349-355

C. Xu, J. Xi and W. Gao, (1996) Isothermal Superplastic Boronizing of High Carbon and Low

Alloy Steels *Scripta Materialia*, Vol.34., No.3, 455-461

Gao Wei and Cantor, B., (1989), The Effect of Heat Treatment and Surface Treatment on the

Crystallisation Behaviour of Amorphous Fe<sub>40</sub>Ni<sub>40</sub>B<sub>20</sub>, *Acta Metallurgica*, 37, 3409-3424