



中国核能行业协会
China Nuclear Energy Association



3rd International Symposium on Materials and Reliability in Nuclear Power Plants

Symposium Guide

Organized by:

China Nuclear Energy Association
Institute of Metal Research, Chinese Academy of Sciences

Sponsored by:

Chinese Academy of Sciences
National Natural Sciences Foundation of China
National Basic Research Program of China (2011CB61050), Ministry of Science and
Technology, China
Liaoning Province Government
Shenyang Municipal Government
Liaoning Key Laboratory for Safety and Assessment Technique of Nuclear Materials

September **14-17, 2013**

Shenyang, China

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3rd International Symposium on Materials and Reliability in Nuclear Power Plants

Chairman:

Prof. En-Hou Han

Institute of Metal Research, Chinese Academy of Sciences, Shenyang, China.

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Ms. Huiyin Jiang China Nuclear Energy Association, Chin

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Introduction of the Symposium

Safety and reliability during the long-term, efficient operation of nuclear power plants (NPPs) have been of great concern of the society, in particular after the Fukushima Daiichi nuclear accident. Design, fabrication and performance of structural materials are key factors dominating the safety and reliability of NPPs. With the rapid development of nuclear power industry in China, design and fabrication of materials for manufacturing the key components have been more important due to the construction of a number of NPPs in the future and the demand for safe and reliable operation of NPPs. In the meantime, there is a more pressing need for research on the environmental degradation of nuclear materials to support the ageing management of key materials and components in the operating NPPs. The First International Symposium on Nuclear Materials-Degradation and Safety in Light Water Nuclear Power Plant, and the Second International Symposium on Materials and Reliability in Nuclear Power Plants have been successfully held in Shenyang, China in 2009 and 2011, respectively. Both symposia brought together more than one-hundred specialists, researchers and engineers from the academia and industry, and made a contribution to understand and remedy the material problems in construction, operation and lifetime-extension of NPPs. The symposium is intended to enhance the cooperation between the academia and industry, as well as to promote the research and development of nuclear materials in China and other countries, and it is held in a two-year series. We expect the third symposium to attain the following goals:

- Discuss on material problems in design, manufacture and operation of the key components in NPPs.
- Discuss on environmental degradation of the key structural materials raised by lifetime extension of NPPs.
- Exchange new ideas, concepts and progress in the research of environmental degradation of materials in NPPs.
- Promote further cooperations between the academia and industry, in efforts to support the operational safety and reliability of nearly one-hundred NPPs in China in the future.

Dining Program

DATE	TIME	PLACE		NOTE
Sept 14 (Sat.)	18: 00—20: 00	7 th floor Western dining room	Buffet	Take the admission ticket.
Sept. 15 (Sun.)	6: 30—8: 30	7 th floor Western dining room	Buffet	Take the admission ticket.
	12: 20—14: 00	7 th floor Western dining room	Buffet	Take the admission ticket.
	18: 15—20: 00	7 th floor Western dining room	Buffet	Take the admission ticket.
Sept 16 (Mon.)	6: 30—8: 30	7 th floor Western dining room	Buffet	Take the admission ticket.
	12: 00—14: 00	7 th floor Western dining room	Buffet	Take the admission ticket.
	18: 15—21: 00	6 th floor Multi-function AB Hall	Banquet	Take the admission ticket.
Sept 17 (Tues.)	6: 30—8: 30	7 th floor Western dining room	Buffet	Take the admission ticket.
	12: 00—14: 00	7 th floor Western dining room	Buffet	Take the admission ticket.

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3rd International Symposium on Materials and Reliability in Nuclear Power Plants

Sept 14-17, Shenyang, China

AGENDA

Date	Time	Topic	Speaker & Organization	Page
Sept 14 (Sat.)	8:00-17:00	Registration		
	18:00-20:00	Welcome Reception		
Sept 15 (Sun.)	8:30-9:00	Introduction to meeting and recognition of sponsors and the leader's address 介绍领导和重要来宾，领导讲话	Chair: Prof. En-Hou Han Institute of Metal Research, Chinese Academy of Sciences 中国科学院金属研究所	
	9:00-9:40	Plenary lecture: Development of Nuclear Power and Research of Material Reliability after Fukushima Accident 后福岛时代核电发展与材料可靠性研究 Chaired by: Prof. En-Hou Han	Mr. Yuming Xu China Nuclear Energy Association 中国核能行业协会	P1

9:40-10:20	Plenary Lecture: Enhancement of SCC in Pressure Vessel Steels by Chloride at ppb Levels ppb 浓度水平氯离子对压力容器钢应力腐蚀开裂的促进作用 Chaired by: Prof. En-Hou Han	Dr. Peter L. Andresen GE Global Research Center GE 全球研究中心	P3
10:20-10:55	Invited Keynote Lecture: Improved Welding Processes for Alloy 52/152 52/152 合金焊接工艺的改进 Chaired by: Prof. En-Hou Han	Dr. Kurt Edsinger Electric Power Research Institute (EPRI) 美国电力研究院	P8
10:55-11:20	Group Photo Tea Break		
	Session 1: Material problems of key components in nuclear island during design and manufacturing Chairman: Dr. Zhimin Zhong, Dr. Chun Gui		
11:20-11:40	Effect of the grain boundary network on the SCC resistance of 304 stainless steel in a simulated PWR water 晶界网络对模拟一回路水中304不锈钢SCC抗性的影响研究	Dr. Shuang Xia Shanghai University 上海大学	P14
11:40-12:00	Defect characteristics of passive films on zircaloy-4 after hydrogen permeation Zr-4 合金渗氢后钝化膜特征	Mr. Yunhan Ling Tsinghua University 清华大学	P16
12:00-12:20	Optimum structure material option of reactor vessel internals in PWR nuclear power plant 压水堆核电站堆内构件结构材料优化选取思考	Mr. Qingtian Wang Nuclear Power Institute of China 中国核动力研究院	P18
12:20-14:00	Lunch		

14:00-14:40	<p>Plenary Lecture: Change in GB strength and compositions prior to SCC initiation during long terms operation 长期服役过程中应力腐蚀开裂萌生前晶界强度与成分的变化 Chaired by: Prof. Xinqiang Wu</p>	<p>Dr. Koji Arioka Institute of Nuclear Safety System (INSS), Japan 日本核安全系统研究院</p>	P2
14:40-15:15	<p>Invited Keynote Lecture: Role of cavity formation on SCC growth of CW TT690, CW Carbon steel, and others in high temperature water 空穴形成对高温水中冷加工 689TT 合金、冷加工碳钢及其他材料应力腐蚀开裂扩展速率的作用 Chaired by: Prof. Xinqiang Wu</p>	<p>Dr. Koji Arioka Institute of Nuclear Safety System (INSS), Japan 日本核安全系统研究院</p>	P10
15:15-15:50	<p>Invited Keynote Lecture: Effect of Flow Rates on SS304 SCC Behaviors in High Temperature Waters 流动速率对高温水环境中 304 不锈钢应力腐蚀开裂行为的影响 Chaired by: Prof. Xinqiang Wu</p>	<p>Dr. Clinton Fong Industrial Technology Research Institute, Taiwan 台湾工业技术研究院</p>	P13
15:50-16:10	Tea break		
	<p>Session 1: Material problems of key components in nuclear island during design and manufacturing Chairman: Prof. Guangfu Li, Prof. Zhanpeng Lu</p>		
16:10-16:30	<p>Study on NCRs of Domestic-Made SA-508 Gr.3 Cl.2 Heavy Forgings for CAP1000 Projects CAP1000 工程中大型国产 SA-508-3 钢锻件的不合格项研究</p>	<p>Mr. Yizhong Yang Shanghai Nuclear Engineering Research and Design Institute 上海核工程研究设计院</p>	P19
	<p>Session 2: Behavior and mechanism of materials degradation in field Chairman: Prof. Guangfu Li, Prof. Zhanpeng Lu</p>		

	16:30-16:50	Deterministic Approach for Quantifying SCC Growth Rates of Ni-base Alloys and Weld Metals in PWR Primary Water Environments 量化研究镍基合金及焊接合金在一回路水环境中裂纹扩展速度的确定性方法	Prof. Zhanpeng Lu Shanghai University 上海大学	P20
	16:50-17:10	Oxidation Corrosion Characteristics of Nuclear-grade Stainless Steel and Nickel-base Alloy in Oxygenated High Temperature Pure Water 含氧高温水中核级不锈钢与镍基合金的氧化腐蚀特性	Prof. Xinqiang Wu Institute of Metal Research, Chinese Academy of Sciences 中国科学院金属研究所	P21
	17:10-17:30	The mechanism of Zn additions effect on behavior of Co deposition in PWR primary conditions 压水堆条件下 Zn 对 Co 在氧化膜中沉积行为的影响机理研究	Mr. Zhengang Duan Shanghai Jiaotong University 上海交通大学	P22
	17:30-18:10	Poster session		
	18:15	Dinner		
Sept 16 Mon.	9:00-9:40	Plenary lecture: Proactive Materials Degradation Management and Some Specific Topics 材料退化的前瞻性管理与一些具体课题 Chaired by: Prof. En-Hou Han	Prof. Tetsuo Shoji Tohoku University 日本东北大学	P5
	9:40-10:15	Invited keynote lecture: Development of an Equipotential DCPD System for the Detection of Cracks in LWR Piping & Welds 轻水堆管道与焊接部位裂纹检出用等电位 DCPD 系统的开发 Chaired by: Prof. En-Hou Han	Prof. Ronald Ballinger Massachusetts Institute of Technology 麻省理工学院	P7

	10:15-10:35	Tea break		
		Session 2: Behavior and mechanism of materials degradation in field Chairman: Prof. Lefu Zhang, Prof. He Xue		
	10:35-10:55	Irradiation Damage in 4H-SiC by Molecular Dynamics Simulation 4H-SiC 辐照损伤的分子动力学研究	Mr. Qingyu Wang Harbin Engineering University 哈尔滨工程大学	P23
	10:55-11:15	Investigation on Stress Corrosion Cracking of Steam Generator Tubing Materials 蒸汽发生器管材的应力腐蚀开裂研究	Dr. Shuangqun Zhao Shanghai Power Equipment Research Institute 上海发电设备成套设计研究院	P26
		Session 3: Behavior and mechanism of materials degradation in laboratory Chairman: Prof. Lefu Zhang, Prof. He Xue		
	11:15-11:35	Stress Corrosion Cracking Behavior of Dissimilar Metal Weld A508/52M in High Temperature Water Environments 异材焊接件 A508/52M 高温水中应力腐蚀破裂行为及应用评价	Prof. Guangfu Li Shanghai Institute of Materials Research 上海材料研究所	P27
	11:35-11:55	Effects of Temperature and Dissolved Oxygen on Crack Growth Rate in 316L Type Stainless Steel 温度及溶解氧对高温高压水中 316L 不锈钢的应力腐蚀裂纹扩展速率的影响	Mr. Donghai Du Shanghai Jiaotong University 上海交通大学	P28
	12:00-14:00	Lunch		
	14:00-14:40	Plenary lecture: SCC of Alloy 690 on secondary side at line contact crevices 二次侧线接触缝隙部位 690 合金的应力腐蚀开裂 Chaired by: Prof. Qunjia Peng	Dr. Roger W. Staehle University of Minnesota 明尼苏达大学	P4

14:40-15:15	Invited Keynote lecture: SCC Vulnerabilities of Alloy 690 in PWR Water 压水堆水环境中镍基 690 合金应力腐蚀开裂的易发性 Chaired by: Prof. Qunjia Peng	Dr. Peter L. Andresen GE Global Research Center GE 全球研究中心	P9
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	Session 3: Behavior and mechanism of materials degradation in laboratory Chairman: Prof. Yonghao Lu, Dr. Zhenfeng Tong		
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15:55-16:15	Influence of ETA on the High-temperature Electrochemical Behavior of Alloy 690 ETA对690合金高温电化学行为的影响	Mr. Jiazhen Wang Institute of Metal Research, Chinese Academy of Sciences 中国科学院金属研究所	P35
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16:55-17:15	Displacement amplitude effects on fretting wear behaviors of Inconel 600 alloy 位移幅度对 Inconel600 合金微动磨损性能的影响	Prof. Yonghao Lu University of Science and Technology Beijing 北京科技大学	P40

	17:15-17:35	Measuring the High-temperature Elasto-plastic Properties of Small Volumes of Metallic Materials by Using the Indentation Technique 应用压痕技术测量小体积金属高温弹塑性	Mr. Chunyu Zhang Sun Yat-Sen University 中山大学	P41
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	10:35-10:55	Development of high temperature high pressure electrochemical measurement electrode device and verification test on large scale facility service 针对大型试验台架的高温高压电化学测量电极装置的研制及试验验证	Dr. Chun Gui, Dr. Tichun Dan Research Institute of Nuclear Power Operation, China National Nuclear Corporation 中核集团核动力运行研究所	P49

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	<p>Reliability Analysis of Safety Related Ventilation System Fan of Nuclear Power Plant 核电厂安全重要通风系统风机可靠性分析</p>	<p>Mr. Xiaotian Liu Suzhou Nuclear Power Research Institute 苏州热工研究院有限公司</p>	P52
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Brief introduction of CNEA

The China Nuclear Energy Association (CNEA), as a national non-profit nongovernmental organization, was established on April 18, 2007. Its objective is to contribute as a bridge for CNEA's members to link with the government and the foreign counterparts. The CNEA's missions are to implement throughout the national policies on nuclear energy development, promote industrial independent innovation and technical advance, and support for improving safety, reliability and economics of nuclear energy utilization.

So, CNEA performs the following duties:

- Organizing communication and cooperation between the members and the government;
- Helping arrange the international exchange for its members with foreign associations and enterprises;
- Carrying out studies on nuclear energy situation, industry development strategy and other key issues, shaping market predict and economic analysis;
- Organizing the peer reviews for operational NPPs;
- Organizing assessment on nuclear power projects under construction and experience exchange;
- Organizing to disseminate information and knowledge concerning nuclear energy utilization and building nuclear safety culture;
- Organizing post training for nuclear energy staff;
- Offering technical consultation and special technical services under authorization by the government and enterprises.

Brief introduction of IMR

The Institute of Metal Research (IMR) was founded in 1953, the first-term director was the distinguished physical metallurgist Prof. Li Xun (Hsun Lee). Prof. Rui Yang is the current director and Prof. Shi Changxu is the honorary director.

In 1999, the Chinese Academy of Sciences (CAS) approved the merge of the Institute of Metal Research (IMR) and the Institute of Corrosion and Protection of Metals (ICPM). This unified body, supported by Knowledge Innovation Program (KIP), forms a new R & D base for advanced materials in the Northeast region of China. New IMR defines its mission as to excel in materials research, develop advanced materials technology and foster exceptional talents, serving the nation, society and mankind.

IMR has established a research system consisting of Shenyang National Laboratory for Materials Science, State Key Laboratory of Corrosion and Protection, Shenyang Advanced Material R&D Center, National Engineering Research Center for Corrosion Control, Environmental Corrosion Center, and Liaoning Key Laboratory for Safety and Assessment Technique of Nuclear Materials. IMR focus mainly on high performance metallic materials, new types of inorganic nonmetallic materials, and advanced composite materials through researching and developing their structures, properties, performances, corrosion and protection, as well as materials engineering such as materials synthesis and fabrication, processing, and application exploration.

In recent years, IMR has made great achievements in the fields of crystal physics, non-equilibrium materials and nano-materials, machinable advanced ceramics, special materials for crucial environments, high temperature titanium alloys, super-alloys, metallic foams, and materials protection techniques, and materials and engineering structures' lifetime prediction.

IMR has a graduate study program to grant master and doctoral degrees in materials science and engineering. At present, more than 600 graduate students are studying at IMR. This is a group of leading young scientists who are working vigorously on the frontier fields and have achieved innovative results.

IMR has kept relationships of scientific exchanges and co-operations with abroad institutions, universities and academic associations from more than 30 countries and regions. There are 40 scientists who are holding positions in more than 50 international academic organizations or journals.

The IMR has been editing and publishing six key academic periodicals and journals on behalf of Chinese Society for Metals, Chinese Materials Research Society, the International Center for Materials Physics (ICMP), the National Natural Science Foundation of China, and the Chinese Society of Corrosion and Protection. They are Acta Metallurgica Sinica (Both English and Chinese Editions), Journal of Material Science & Technology (English Edition), Chinese Journal of Materials Research (Chinese Edition), Journal of Chinese Society for Corrosion and Protection (Chinese Edition), and Corrosion Science and Protection Technology (Chinese Edition).