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## Announcement

- The 1<sup>st</sup> Board meeting will be held on September 26, 2014 at National Sun Yat-sen University, Kaohsiung City, Taiwan.
- 2014 International Conference on Aerosol Science & Technology has been held on September 26-27 at National Sun Yat-sen University.

We would like to invite all of the members to share you research or new aerosol knowledge with us. Thank you very much for your support and help. Best wishes to you and your family!



頒發秋森獎  
 中國鋼鐵股份有限公司 李興旺 博士(右)



頒發最佳學術論文獎  
 中國醫藥大學 楊禮豪 副教授(右)

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- ◎E-mail : taarasst@gmail.com

## Introducing 12th Directors and Supervisors of TAAR

Position	Name
President	Chih-Chieh Chen
Standing Director	Moo-Been Chang
Standing Director	Wen-Yinn Lin
Standing Director	Perng-Jy Tsai
Standing Director	Ken-Hui Chang
Director	Lin-Chi Wang
Director	Hsi-Hsien Yang
Director	Guo-Ping Chang-Chien
Director	Long-Full Lin
Director	Ying-I Tsai
Director	Chang-Tang Chang

Position	Name
Director	Shun-I Shih
Director	Yuan-Chung Lin
Director	Wang-Kun Chen
Director	Ta-Chih Hsiao
Substitute Director	Hsing-Cheng Hsi
Substitute Director	Yu-Chih Lin
Standing Supervisor	Jung-Pin Yu
Supervisor	Kuo-Lin Huang
Supervisor	How-Ran Chao
Supervisor	Lian-De Hsieh
Supervisor	Hung-Min Chein
Substitute Supervisor	Hsing Chao

# Aerosol Researcher Profile – Prof. Hsing-Cheng Hsi

**Name** : Hsing-Cheng Hsi

**Position** : Professor

**Affiliation**: Graduate Institute of Environmental Engineering, National Taiwan University

**Education**:

Ph.D. Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign

M.S. Graduate Institute of Environmental Engineering, National Taiwan University

B.S. Department of Agricultural Chemistry, National Taiwan University

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The two main themes of Dr. Hsi's researches are on environmental toxin investigation and control strategy development, especially focusing on Hg and methyl Hg investigation and control, as well as other metal compounds and dioxins/furans. Researches also focus on developing novel adsorbents and chemical/photo catalysts on toxin emission control. Some collaborative works are launching on Hg/methyl Hg exposure assessment.

## Representative Research Topics

### 1. Multipollutant Control of Hg/SO<sub>2</sub>/NO from Coal-Combustion Flue Gases Using Transition Metal Oxide-Doped SCR Catalysts

This research investigated the effects of transition metal oxide doping on the physical/chemical properties and the multipollutant (i.e., Hg/SO<sub>2</sub>/NO) control of a V<sub>2</sub>O<sub>5</sub>-WO<sub>3</sub>/TiO<sub>2</sub>-SiO<sub>2</sub> selective catalytic reduction (SCR) catalyst. Additional V, Mn, and Cu oxides of 5 wt% were doped onto the catalyst surface. The doped metal oxides presenting in nanoscales caused an increase in total surface area of catalysts. SEM images suggested that the raw and treated catalysts presenting as bean-shaped nanoparticles within 10–30 nm. V<sup>4+</sup>/V<sup>5+</sup>, Mn<sup>4+</sup>, and Cu<sup>2+</sup> were the major valence states presenting on the surface of VO<sub>x</sub>-, MnO<sub>x</sub>-, and CuO<sub>x</sub>-doped catalysts, respectively. Hg<sup>0</sup> oxidation, SO<sub>2</sub> removal, and NO

reduction of the SCR catalyst can be enhanced after the metal oxide doping.  $\text{VO}_x$ - and  $\text{CuO}_x$ -doped catalysts not only had excellent  $\text{Hg}^0$  oxidation but also had great NO reduction. However, the enhancement in  $\text{SO}_2$  removal after metal oxide doping, which was assumed to be partly caused from increasing  $\text{SO}_2$ – $\text{SO}_3$  conversion, may be of concern considering the potential downstream corrosion. Langmuir-Hinshelwood model can successfully explain the  $\text{Hg}^0$  oxidation by  $\text{VO}_x$ - and  $\text{MnO}_x$ -doped catalysts. Overall, multipollutant emission control using surface-doped SCR catalysts can be practically applied at 350 °C under the tested coal-combustion flue gas condition.

## **2. Novel Synthesis of Visible-Light $\text{TiO}_2$ in Single Step Using Thermal Plasma for Low-Concentration Elemental Mercury Removal**

Oxygen-vacant titanium dioxide ( $\text{TiO}_{2-x}$ ) nanoparticles possessing a narrower band gap were synthesized with a single-step process using  $\text{N}_2/\text{He}/\text{Ar}$  thermal plasma as a heating source. Samples with diverse characteristics were developed and the elemental mercury ( $\text{Hg}^0$ ) removal effectiveness was subsequently evaluated. N- $\text{TiO}_2$  and C- $\text{TiO}_2$  were also synthesized using impregnation methods.  $\text{TiO}_2$  nanoparticles possessing high purity and uniform particle sizes were successfully synthesized using metal titanium and  $\text{O}_2$  as precursors and Ar as plasmas gas.  $\text{TiO}_{2-x}$  in anatase phase with a particle size at 5–10 nm was formed at the He/Ar volume ratio of 25/75. Further increasing the He/Ar ratio elevated the plasma temperature, causing the tungsten to melt, vaporize from the cathode, and then dope into the formed  $\text{TiO}_2$  nanoparticles. In the case of  $\text{N}_2$  mixed with He and Ar as the plasma gas, sample characterization showed that the formed  $\text{TiO}_{2-x}$  nanoparticles had a size within 5–40 nm and was in a mixing from of anatase and rutile. An evident absorption red shift to 470 nm wavelength was observed. The deconvolution results of XPS spectra supported the formation of  $\text{TiO}_{2-x}$  due to the presence of  $\text{Ti}^{3+}2p$  peaks. The Hg removal efficiency of  $\text{TiO}_{2-x}$  nanoparticles increased with increasing  $\text{O}_2$  concentration and in the presence of light irradiation, suggesting an enhancement in  $\text{Hg}^0$  oxidation.  $\text{H}_2\text{O}$  molecules, however, greatly reduced the Hg removal of  $\text{TiO}_{2-x}$  under visible-light (VL) irradiation. The photoinduced hydrophilicity of  $\text{TiO}_{2-x}$  under VL irradiation was suspected to amplify the competitive adsorption of  $\text{H}_2\text{O}$  that decreased Hg capture. Hg removal performances at 50 °C were better than those at 25 °C and 100 °C,

suggesting that both adsorption and catalytic oxidation limit the Hg removal.  $\text{TiO}_{2-x}/\text{ACF}$  composite was also manufactured with thermal plasma evaporation condensation system to confirm  $\text{TiO}_{2-x}$  effectiveness on  $\text{Hg}^0$  removal under VL.

### **3. Mercury Emission, Speciation and Distribution of Coal-Fired Power Plants in Taiwan and Discussion on Potential Speciation Errors**

These studies investigated the Hg speciation and distribution at CFPPs in Taiwan. The tested CFPP is equipped with low- $\text{NO}_x$  burners and SCR for  $\text{NO}_x$  control, cold-side ESP for particulate capture, and wet FGD for  $\text{SO}_x$  removal. Samplings of all the relevant Hg inputs and outputs, including coal, lime, bottom ash/slag, fly ash, gypsum slurry and flue gases were performed. The  $\text{Hg}_p$ ,  $\text{Hg}^0$ ,  $\text{Hg}^{2+}$  concentrations/mass flow rates were measured and calculated. Mass balances for Hg throughout the entire power plant were subsequently obtained. Results showed that the coals used in Taiwan contained small amount of Hg, however, coal burning is still the main contributor compared to lime. Mass balance results showed > 80% recovery, confirming the accuracy of measurement. Fly ash, gypsum, and exhaust gas are the three main Hg outputs. Mercury speciation is largely dependent on pollution control devices, which remove 80-90% of total Hg and result in the outlet Hg concentration <  $5 \mu\text{g}/\text{Nm}^3$ . OH method may over-estimate the concentration of  $\text{Hg}_p$  when sampling was performed in high-ash-loading region. Some  $\text{Hg}_p$  may partly belong to  $\text{Hg}^0$ . Ash-free sampling may limit the over-estimation but additional evaluation is needed.



Nantou, Taiwan

## Aerosol Information Update

Title: Environmental Engineering: Fundamentals, Sustainability, Design

Authors: James R. Mihelcic, Julie B. Zimmerman

Hardcover: 704 pages

Publisher: Wiley; 2 edition (January 13, 2014)

Language: English

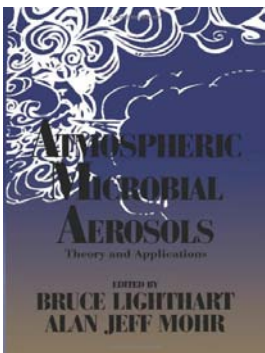
ISBN-10: 1118741498

ISBN-13: 978-1118741498



### Book Description

*Environmental Engineering: Fundamentals, Sustainability, Design* presents civil engineers with an introduction to chemistry and biology, through a mass and energy balance approach. ABET required topics of emerging importance, such as sustainable and global engineering are also covered. Problems, similar to those on the FE and PE exams, are integrated at the end of each chapter. Aligned with the National Academy of Engineering's focus on managing carbon and nitrogen, the 2<sup>nd</sup> edition now includes a section on advanced technologies to more effectively reclaim nitrogen and phosphorous. Additionally, readers have immediate access to web modules, which address a specific topic, such as water and wastewater treatment. These modules include media rich content such as animations, audio, video and interactive problem solving, as well as links to explorations. Civil engineers will gain a global perspective, developing into innovative leaders in sustainable development.



Title: Atmospheric Microbial Aerosols: Theory and Applications

Authors: Bruce Lighthart, Alan Jeff Mohr

Paperback: 408 pages

Publisher: Springer; Softcover reprint of the original 1st ed. 1994 edition (October 4, 2013)

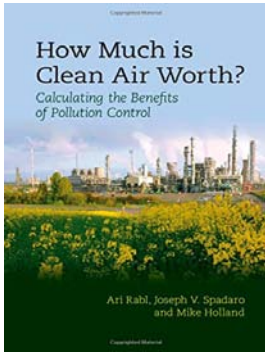
Language: English

ISBN-10: 146846440X

ISBN-13: 978-1468464405

### Book Description

A bioaerosol is a colloidal suspension of liquid droplets or solid particles in air whose components contain or have attached to them one or more microorganisms. Bioaerosols are an exciting and vital object of study because the attached microbes play a critical role in human, animal and environmental health. In an era of genetically engineered microorganisms and the application of biopesticides, bioaerosols are increasingly an environmental problem, both indoors and outdoors, and can affect entire ecosystems. *Atmospheric Microbial Aerosols* examines naturally occurring bioaerosols, as well as bioaerosols generated by human activity. Included in this volume is a complete array of topics concerned with outdoor microbial bioaerosols ranging from the physical and chemical to the meteorological and microbial. It will be of great interest as a starting point for researchers interested in outdoor microbial bioaerosols as well as for those interested in atmospheric dispersion models, new equipment, and government regulations.

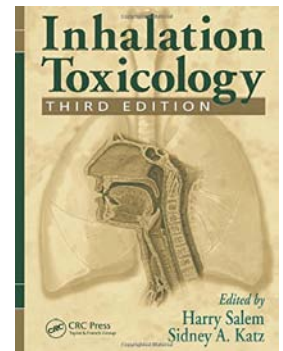


Title: How Much Is Clean Air Worth?: Calculating the Benefits of Pollution Control  
Authors: Ari Rabl, Joseph V. Spadaro, Mike Holland  
Hardcover: 695 pages  
Publisher: Cambridge University Press (August 29, 2014)  
Language: English  
ISBN-10: 1107043131  
ISBN-13: 978-1107043138

## Book Description

How Much is Clean Air Worth? offers readers a comprehensive overview of the core methodologies and tools used to quantify the impacts and damage costs of pollution. The book begins by reviewing the tools used for environmental assessments and shows that a rational approach requires an impact pathway analysis (IPA) for each of the possible impacts of a pollutant, i.e. an analysis of the chain emission -> dispersion -> exposure-response functions -> monetary valuation. The IPA methodology is explained in full and illustrated with worked examples, and difficulties are discussed and uncertainties analysed. In addition to detailed computer models, a very simple model (the 'Uniform World Model') is presented, enabling readers to make estimates for cases where no results are available. Published results for electricity, waste treatment and transport are reviewed, with a thorough discussion of policy implications. This book will appeal to a broad mix of academics, graduate students and practitioners in government and industry working on cost-benefit analysis, environmental impact analysis and environmental policy.

Title: Inhalation Toxicology, Third Edition  
Editors: by Harry Salem, Sidney A. Katz  
Hardcover: 623 pages  
Publisher: CRC Press; 3 edition (August 19, 2014)  
Language: English  
ISBN-10: 1466552735  
ISBN-13: 978-1466552739



## Book Description

The lungs provide a significant opportunity for the introduction of both therapeutic and toxic chemicals into the human body. In occupational and domestic environments, hazardous chemicals can enter the body through the lungs via gases, aerosols, and particulates from natural and anthropogenic sources. Fully updated with new research and discoveries since the last edition, **Inhalation Toxicology, Third Edition** presents contributions from internationally recognized scientists in the academic, commercial/industrial, and governmental sectors. A pragmatic resource for practicing professionals and students, the book comprehensively examines the relationship between the respiratory system and the toxicology of inhaled substances.

## Calendar of Events

Conference Schedule	Name of Conference	Location
November 18-20, 2014	4th International Conference NANOSAFE 2014 <a href="http://www.nanosafe.org/scripts/home/publigen/content/templates/show.asp?P=145&amp;L=EN">http://www.nanosafe.org/scripts/home/publigen/content/templates/show.asp?P=145&amp;L=EN</a>	Grenoble, France
January 4-8, 2015	95th AMS Annual Meeting <a href="http://annual.ametsoc.org/2015/">http://annual.ametsoc.org/2015/</a>	Phoenix, Arizona, USA
April 12-15, 2015	2nd International Congress on Safety on Engineered Nanoparticles and Nanotechnologies - SENN 2015 <a href="http://www.ttl.fi/ARTNER/SENN2015/Pages/default.aspx">http://www.ttl.fi/ARTNER/SENN2015/Pages/default.aspx</a>	Helsinki, Finland
June 22-25, 2015	A&WMA's 108th annual Conference & Exhibition Connecting the Dots: Environmental Quality to Climate <a href="http://ace2015.awma.org/">http://ace2015.awma.org/</a>	Raleigh Convention Center, USA
June 30 - May 3, 2015	20th Congress of the International Society for Aerosols in Medicine (ISAM) <a href="http://www.isamcongress.com/">http://www.isamcongress.com/</a>	Munich, Germany
September 6-11, 2015	European Aerosol Conference (EAC 2015) <a href="http://www.eac2015.it/">http://www.eac2015.it/</a>	Milan ,Italy
October 12-16, 2015	AAAR 34th Annual conference <a href="https://www.aaar.org/index2.cfm?section=Meetings_and_Events">https://www.aaar.org/index2.cfm?section=Meetings_and_Events</a>	Minneapolis, Minnesota, USA

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