Particuology 27 (2016) 141–143

Contents lists available at ScienceDirect

Particuology

journal homepage: www.elsevier.com/locate/partic

News & Views

2nd UMN–CAS Bilateral Seminar on $PM_{2.5}$ science, health effects and control technologies, October 7–8, 2015 at 3M Innovation Center, Maplewood, MN, USA

The First UMN–CAS Bilateral Seminar was successfully held in Xi'an, China, May 27–28, 2014. A summary of the 1st Bilateral Seminar was published in *Particuology* 16 (2014), 227–229. The Second UMN–CAS Bilateral Seminar was held at 3M Innovation Center, St. Paul, Minnesota, October 7–8, 2015. We are grateful to 3M Coordinator Andrew Viner for hosting the Seminar at the high-tech facility. Although President Chunli Bai of the Chinese Academy of Sciences (CAS) could not be at the Seminar, we appreciate he sent a congratulatory message to the attendees to encourage our in-depth discussion on the $PM_{2.5}$ topics important to China. The day before the Seminar on October 6th, Minnesota Governor Mark Dayton received the Chinese delegates at the Minnesota State Capitol in St. Paul and emphasized the importance of collaborations between China and U.S. The delegates also toured several Center for Filtration Research (CFR) local companies, including Donaldson Company, 3M Company, MSP Corporation, and TSI Incorporated. We also appreciate 3M Vice President John Banovetz for his greetings to the attendees. We had 35 Chinese delegates, 25 UMN (University of Minnesota) delegates, and 65 CFR delegates, for a total of 125 delegates attending the meeting. The stated goals of the Bilateral Seminar are: (1) to provide networking opportunities among leading $PM_{2.5}$ experts at UMN, CAS/Universities in China, and leading global filtration companies, and (2) to identify top emerging areas in $PM_{2.5}$ science/economic analysis, health effects, and control technologies for research cooperation among the delegates. During the two-day seminar, we had arranged presentations by the panelists, breakout session discussions, and networking opportunities for the delegates. The panelists are all leading scientists from their respective fields in academia, industry and government. We would like to thank the Panel Leaders: Panel 1, $PM_{2.5}$ Health Effects, Prof. Jeff Mandell and Prof. Guangbiao Zhou; Panel 2, $PM_{2.5}$ Science and Economics, Prof. Thomas Kuehn and Prof. Shuncheng Lee; and Panel 3, Control Technologies, Prof. Jing Wang and Prof. Yunfa Chen. They moderated the panel presentations, guided the discussion at their respective breakout session, and prepared a summary of the panel discussions.

The Third UMN–CAS Bilateral Seminar is now planned for July 28–30, 2016, which will be hosted by Managing Director Lihua Zhang of Yancheng Environmental Technology Science and Technology City, Jiangsu Province, China.

Panel 1: Summary of $PM_{2.5}$ Health Effects (Jeff Mandell, Charles Lo, Guangbiao Zhou)

The Health Effects Group met with members from the Chinese Academy of Sciences, the University of Minnesota Medical School, the University of Minnesota School of Public Health and two other individuals, William Wilson, former administrator for the U.S. EPA and Andy Fox, who currently works for 3M Shanghai and interacts frequently with scientists in China in his capacity.

The meeting started with a general discussion of the planning process for a collaborative project that combined the unique talents and experiences from all of the participating institutions. It was also acknowledged that such a project should have practical applicability to the health effects of $PM_{2.5}$, as the main focus. It was pointed out that interaction for the group was possible in two ways:

One is individual interaction between China and U.S. scientists to pursue individual's research interests. Dr. Wilson is interested in applying his epidemiology model to study total health effects of $PM_{2.5}$ on cardiovascular mortality. Dr. Ailan Chen expressed her interest and support in assisting Dr. Wilson's study.

Another is a larger project focused around the use of biomarkers to identify exposures and/or diseases of interest. A key strategy was to use biomarkers as a means of identifying people in higher exposure categories or to identify people in early stages of a disease (secondary prevention). If these types of biomarkers could be identified, it would enable a more effective way of managing exposed and/or diseased populations prior to the development of more complicated disease.

A multi-stage process was discussed as an approach to developing this project. The first stage involved the identification of cohorts that might be used in further biomarker research. The second stage involved the identification of biomarkers that could be possibilities for use in future research. The final stage(s) would involve the use of the identified biomarkers in a research setting(s), to determine their sensitivity, specificity and predictive value.

Several cohorts were discussed for potential use. Faculty members from the University of Minnesota have previously been in contact with Chinese investigators to identify cohorts that could be used in this undertaking. Cohorts in the U.S. were also identified for this purpose. These prior discussions have indicated willingness on both sides to share information, including blood products, and to collaborate.

It was suggested that, in addition to learning about information collected on these cohorts, the group would benefit from further information that describes any exposure measurements made that involved these cohorts. Actual $PM_{2.5}$ exposure measurements are available for one of the Chinese cohorts, in addition to particle composition data. This will be distributed to the group via e-mail. Similarly, a description of the U.S. cohort will be distributed along with information regarding exposure. This latter cohort is

http://dx.doi.org/10.1016/j.partic.2016.05.001
1674-2001/

occupational in nature but has detailed exposure information, including $PM_{2.5}$ exposure estimates.

It was suggested by the group that joint funding from China and the U.S. was preferable. Potential funding agencies are: U.S. National Institute of Environmental Health Sciences, U.S. National Sciences Foundation. For China: The Ministry of Science and Technology, National Natural Science Foundation of China, Chinese Academy of Sciences and the U.S. National Sciences Foundation through its Beijing office. Private funding was also discussed briefly as a means of supplementing projects.

Further dialog will occur following the distribution of the abovementioned information. Additional exchanges would be planned after this, including the possibility of another exchange during the 3rd Bilateral Seminars, pending its status.

Panel 2: Summary of $PM_{2.5}$ Science and Economics (Thomas H. Kuehn and Shun-Cheng Lee)

Attendees discussed several ideas that would promote the understanding and implementation of clean air science and technology and identified four tasks toward this goal.

Additional work is needed to better understand existing sensors and to develop new low-cost sensors for both gases and particles. Work is also needed on larger, more sophisticated instruments to provide better speciation. Measurements are needed at both large and small scales, low cost sensors would promote the implementation of small scale measurements. Advances in wireless technology will support simultaneous data collection and sharing from distributed sensors on a scale previously unattainable.

Only one presentation on economics was given at this meeting. Additional effort needs to be made to include the economics of proposed solutions so that they are more acceptable to the authorities charged with making investment decisions. The first task is to invite a keynote speaker on economics to the meeting next year and work on soliciting more presentations from experts with expertise in economics.

A lengthy review paper was written and published as a result of the first bilateral seminars last year. However readers are more likely to read shorter, more focused articles. Review papers could be written in areas of control for stationary and mobile sources, health issues, and sensors. The second task is that Professor Da Ren Chen, Dr. Xiaoling Wang and Professor Fumo Yang will write a short review article on sensor technology.

Joint research projects between U.S. universities and universities and institutes in China would accelerate mutual understanding of issues and facilitate the use of resources on both sides to address problems. Co-advising by researchers in industry would bring additional insight to the issues at hand and may provide a different viewpoint. The key limitation is the funding that may be available, primarily from the U.S. side. The third task is that Professor Pui investigates potential resources for international collaboration from U.S. agencies such as NSF and NASA and Professor Cao investigates potential funding from China.

In the first two seminars, presentations have been made to other speakers and invited attendees. It is thought that more impact would be made if significantly more interested people would attend such as students or young faculty members who may be looking for suggestions for their own careers in environmental science, economics and or policy. The fourth task is to extend the meeting next year by one or two days, include a workshop or short course in related disciplines, and invite 50 to 100 students and young faculty members to attend the workshop and seminar.

Panel 3: Summary of $PM_{2.5}$ Control Technologies (Jing Wang, Yunfa Chen)

The Chinese government has placed air pollution control as a top priority of the national strategy, evidenced by the revised environmental protection law, national action plan for air quality and related regulations published in the recent years. The national average level of $PM_{2.5}$ has been decreasing in the recent years. The Chinese central and local officials are learning fast about pollution control and are committed to improving the air quality. There are still concerns of the reinforcement of the air quality standards in China. The government needs to ensure the regulations are strictly implemented. Air pollution control need to be achieved by technical approaches and involvement of the public on the societal level.

Major pollution sources in China are still power stations, steel production plants, cement industry, etc. The current particulate matter emission limits for these industries are generally in the range of 20–30 mg/m^3, and should be further reduced, e.g. to 10 mg/m^3. Small scale boilers are not monitored, however, they may emit significant amount of pollutants due to their large number. It would be helpful to develop more automated monitoring and control techniques which can reduce the human influence and enforce the emission standards. Emissions from vehicles are also a significant contributor. The fuel sulfur content in China is expected to be below 10 ppm at the end of 2017, however, even if the production processes meet the standard, there still exist questions for transportation, storage and manipulation. Low sulfur content directly contributes to low emissions of sulfur dioxide and reduces secondary aerosols, in addition, decreases the inhibitive effects of sulfur on the emission control performance of catalyst technology. In regions where low sulfur fuel is not available, sulfur-tolerant catalyst technology should be implemented. More advanced engine technologies and exhaust post treatment systems are available. The Chinese regulations need to be more stringent to generate market needs of these techniques.

In addition to emission reduction, exposure to the airborne pollutants should be controlled. Improvement of the indoor air quality is in the interest of all the households, therefore this market has significant potential. Photochemical reaction with catalysts may be an effective way to remove volatile organic compounds (VOCs), NO_x, SO_x, etc. They can be used in the indoor environment, or used in the large scale air cleaning systems at the city scale. Careful engineering for photo-oxidization is needed to avoid generation of secondary pollutants.

The long term air quality control needs holistic efforts by the entire nation. Economic growth and societal stability needs to be harmonized with the efforts of environmental protection. The government and the industry should coordinate to lower the emission standards and to improve the fuel quality. The general public needs to contribute by using existing lower-emission techniques, consuming less energy and reducing waste and pollutants. China economy is facing a slower growing rate, which may be an opportunity to remove the oversized industries or upgrade the emission control technologies. The economy slow-down in the short term may lead to less emissions. In the long run, Chinese economy growth should depend more on technology intense sectors and service industry, so emissions may be further reduced.

David Y.H. Pui *
University of Minnesota, MN 55455, USA

Junji Cao
Institute of Earth Environment, Chinese Academy of Sciences, Xi'an, China

Jeff Mandell
University of Minnesota, MN 55455, USA

Charles Lo
University of Minnesota, MN 55455, USA

Guangbiao Zhou
Institute of Zoology, Chinese Academy of Sciences, Beijing, China

Thomas T. Kuehn
University of Minnesota, MN 55455, USA

Shun-Cheng Lee
The Hong Kong Polytechnic University, Hong Kong, China

Jing Wang
ETH Zürich, Zürich CH-8093 and Empa, Dübendorf CH-8600, Switzerland

Yunfa Chen
Institute of Process Engineering, Chinese Academy of Sciences, Beijing, China

*Corresponding author.
E-mail address: dyhpui@umn.edu (D.Y.H. Pui)

(From left to right)
Row 1: Zhengtian (Zach) Xu, William E. Wilson, Polance Lee, Doris Segets, Charles Lo, Fumo Yang, Monica Jiamao Zhou, Ailan Chen, Xiaoqing Liu, Sherrie Elzey, Chris Wendt, Caroline Ylitalo, Jing Sun, Yan Wang, Guangbiao Zhou, Norikazu Kurano; **Row 2**: Unknown, Tom Katz, Marshall Hertz, Qiyuan Wang, Leo Nanying Cao, Xiaofeng Xie, Xiaoliang Wang, David Y.H. Pui, Hongchun Zhang, Junji Cao, Lihua Zhang, Tian Yu, Daren Chen, Beau Farmer; **Row 3**: David Kittelson, Taihong Wang, Juehui Hong, Jerry Liu, Zhongbing Lu, Yuan Shao, G. Ramachandran, Yuejin Li, Andreas Scope, Jie Xu, Jacob Liu, Qingquan Zhang, Brian Osmondson, Ruzhao Cheng; **Row 4**: Qisheng Ou, Qingfeng Cao, Frank Liu, Bongryeol Yeom, Hyoung Sun Park, Rony Arauz, Jeffrey Mandel, Jianwen Zhao, Wenjun Ding, Yusuke Sekiguchi, Dylan Millet, Frank Shun-Cheng Lee, Dahai Zhao; **Row 5**: Zhiqiang Deng, Neal Rakow, Shawn Chen, Jing Wang, Jingxian Liu, Rodney Hehenberger, Charles Shaklee, Richard Padbury, Bruce Li, Wolfgang Ruettinger, Peter Vodak; **Row 6**: Andy Fox, Andy Viner, Joan Gao, Jerry Bark, Chao-Hsin Lin, Thomas Kuehn, John Sebastian, Cordell Hardy, Ming Ouyang, Matti Maricq, John Banovetz, Jianguo Liu, Yunfa Chen, Nicholas Stanley.