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Regional Environment Sustainable Development  
2021, Kanazawa

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March. 5. 2021

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Kanazawa, Mar. 5, 2021.

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March. 5, 2021, Online

## **PREFACE**

The role of environmental science and engineering in sustainable design has aroused interests and discussions in both academia and profession in the worldwide.

Kanazawa University will host the Regional Environment Sustainable Development Symposium which focus on topics related to the environment and provide a hybrid-type forum to promote the exchange of information, ideas and knowledge among scientists, engineers, and students.

This symposium is co-organized by the Regional Environment Sustainable Development (RESD) commission, which Kanazawa University joined from 2017. RESD program is firstly launched from Tsinghua University for exchange of PhD candidates from Asian Universities including Tsinghua University, Tongji University in China, Tohoku University and Kanazawa University in Japan, Korea Institute of Science and Technology, Gwangju Institute of Science and Technology and Pohang University of Science and Technology in Korea. In 2021, Kanazawa University acts as host for RESD program, and pre-meeting of RESD program will be held in March.5, 11:50-13:00 (Japanese time zone) in Kanazawa too.

We sincerely invite you to participate and speak on the 2021 EETP Symposium, on March 5, 2021 at Kanazawa University, Japan.

### **Co-organised by RESD Commission on**

#### **Regional Environment Sustainable Development:**

- Kanazawa University
- Tohoku University
- Tsinghua University
- Tongji University
- Korea Institute of Science and Technology
- Gwangju Institute of Science and Technology
- Pohang University of Science and Technology

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## **AIM OF THE SYMPOSIUM**

The study of Regional Environment Sustainable Development is the frontier and hot spot of the current economic and environmental development of the society, and environmental science and engineering plays an important role in achieving the goal of sustainable development. Therefore, it has attracted a lot of attention and discussion from various academic circles at home and abroad.

The good and sustainable development of the regional environment is not only to achieve a natural and environmentally friendly social development, but also to reach a low-carbon, sustainable development of the city, a synergistic development of ecology and economy, an increase in resource use efficiency and ecological balance, and a basic framework for the future development of the city and the region.

2021 Symposium on Environment, Eco-Technology and policy in East Asian “Regional Environment Sustainable Development” aims to provide an international forum for the exchange of ideas and information on research content, methodologies, challenges, research findings, as well as relevant policies and measures adopted by individual countries for sustainable development and practical experiences in the field of regional environmental sustainability and its related disciplines, with a view to achieving the ultimate goal of global sustainable development.

### **Supported by**

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**Primary session** ■

## **Composition and distribution characteristics of microplastics in the water and sediments of urban rivers in Beijing**

Prof. Jiane, ZUO

*Vice dean, Tsinghua Shenzhen International Graduate School, Tsinghua University*

**Abstract:** It has been confirmed that microplastics widely exist in the natural environment, causing potential harm to organisms and humans. In this study, the North Canal and Huai River in Beijing were chosen as the main targets, and eight site points of water samples and three site points of sediments samples were placed along these two rivers, comparing the composition and distribution characteristics of the abundance, particle size, color, shape and species of microplastics. The results showed that the abundance of microplastics in the water and sediments of the North Canal was  $(1941.0 \pm 201.3) \sim (8155.0 \pm 1781.3) \text{ n} \cdot \text{m}^{-3}$  (n refers to the number of microplastics) and  $(120.0 \pm 11.3) \sim (268.0 \pm 31.1) \text{ n} \cdot \text{kg}^{-1}$ , respectively. The average abundance in the water of the North Canal was  $4160.4 \text{ n} \cdot \text{m}^{-3}$ . Compared with the North Canal, the pollution degree of microplastics in Huai River was lower and the average abundance of microplastics was  $2356.7 \text{ n} \cdot \text{m}^{-3}$ . Besides, the abundance of microplastics in the water and sediments in the upper reaches of the North Canal was higher than that in the lower reaches, which had obvious spatial distribution characteristics, but there was no significant difference in the distribution of microplastics in the water of Huai River. The statistical results of particle size, color and shape showed that the main particle size range of microplastics at all site points was  $<300 \mu\text{m}$ ; white/transparent microplastics (50.75%~83.91%) were the most common; fragment (50.00%~95.08%) and fiber (3.86%~30.00%) were the main shapes of microplastics. Polyurethane (PU) and Ethylene vinyl acetate (EVA) were two main plastic species at all site points. Microplastics in the water and sediments of the North Canal may mainly come from urban construction and economic development, while the surrounding villages and residents' daily life may mainly affect the abundance of microplastics in Huai River.

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*2021*

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## **Introduction and Research of Graduate School of Environmental Studies, Tohoku University, Japan**

**Prof. Noriyoshi TSUCHIYA**

*Dean of Graduate School of Environmental Studies, Tohoku University*

**Abstract:** The Graduate School of Environmental Studies (GSES), Tohoku University, offers 2 schools: the Department of Environmental Studies for Advanced Society and the Department of Frontier Sciences for Advanced Environment. The Department of Frontier Sciences for Advanced Environment consists of three educational courses such as Eco-materials and Processing, Applied Environmental Chemistry and Cultural Environmental Studies. We study 'Energy', 'Resources' 'Society' and 'Human' in terms of Environment.

## **Integration of Two Waste Steams for Carbon Storage and Utilization via Carbon Mineralization**

Prof. Youngjune PARK

*School of Earth Sciences and Environmental Engineering, Gwangju Institute of Science and Technology*

**Abstract:** In order to mitigate the anthropogenic CO<sub>2</sub> emissions, carbon capture, utilization and storage (CCUS) technologies are recognized as a plausible option. CCUS technologies include capturing CO<sub>2</sub> from large points sources, such as fossil fuel-based industrial facilities, transporting this CO<sub>2</sub> to storage or utilization sites, and finally sequestering it in geological formations or converting it into fuels/chemicals. On the other hand, carbon mineralization, which involves spontaneous reactions between CO<sub>2</sub> and alkaline earth elements (i.e., Ca and Mg), resulting in forming stable solid carbonates (i.e., CaCO<sub>3</sub> and MgCO<sub>3</sub>) would play double duty as CO<sub>2</sub> storage and utilization, simultaneously – the solid carbonates are not only the thermodynamically most stable form of carbon so that long-term CO<sub>2</sub> storage can be achieved, but also the final products, such as CaCO<sub>3</sub> can be utilized in various applications, such as cements and construction materials so that it could reduce the overall expense in CCUS technologies. Note that carbon mineralization can employ both naturally-occurring minerals (e.g., wollastonite, serpentine, and olivine) and industrial solid wastes (e.g., steelmaking slags, coal ash, and cement kiln dusts). Herein, novel carbon mineralization process was investigated focusing on steelmaking slags. Metal ions such as Ca, Mg, Si, Al, and rare earth elements were efficiently extracted and recovered from the solid slags with pH-swing processes, and tailored synthesis of high purity solid carbonates was achieved for potential application to construction and building materials. A custom-built 10 KG/day scale carbon mineralization demo reactor was also utilized for further scalable study.

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## **Overview from Historical Wisdom to Modern Miracles: Experience from Chinese Urban Planning and Practices**

Prof. Lanchun, BIAN  
*Tsinghua University*

**Abstract:**

## From Tsingtau to Qingdao

Prof. Klaus R. Kunzmann  
*University College of Dortmund*

**Abstract:** Qingdao is a thriving port city on the coast of the Yellow Sea in the Shandong province of the Peoples Republic of China with a population of around 9 million. During 1897 to 1914 the city had been a German mandated territory, named Tsingtau. The city is an important industrial centre, one of the biggest ports in China, a centre of advanced seas and oceans science-technology research and development, a UNESCO city of film, a much favoured tourist city, and not to forget, the production site of the famous Tsingtau beer offered in Chinese restaurants all over the world. The “German” history of the city is still visible in Qingdao. In contrast to many other cities in China, the old city centre of Qingdao has been almost fully preserved. It is well protected, but is looking ahead to benefit from professional and economically viable urban regeneration policies. The essay will introduce into the “German” history of the city and the innovative land regulation, the German administration had launched to avoid excessive land speculation 100 years ago. Achievements of modern city development, such as the Sino-German Eco-development Park are presented. The essay will end with a brief account of challenges the city will face in the years ahead to conserve its historical heritage and meet the requirements of a modern Chinese metropolis.

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*2021*

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## Untitled

Dr.Bing WU  
*Tongji University*

**Abstract:**



**Pararall session** ■  
Regional Environment  
Sustainable Development



## **Internationalization for Graduate Education**

Prof. Ye WU

*Assoc. Dean, School of Environment, Tsinghua University*

**Abstract:** School of Environment has been actively involved in internationalization for graduate education. The proportion of foreign students in SOE has been kept above 9% in recent years with contrast to ~7% averagely from the Uni. A series of international joint/dual degree programs have been launched since the last decade. A number of regional academic exchange projects have also been designed and running well such as RESD. Many top institutes have been SOE's partners such as Kanazawa, Kyoto, Tohoku, Postech, Nanyang Tech. (Asia), Yale, Michigan, WashU (US), and Wageningen, ParisTech, ENPC, Padova (EU). However, like most of the international activities, SOE has been facing a big challenge because of the COVID-19 epidemic with regard to internationalization. Multiple alternatives including online coursework and meetings have undertaken a great task during the difficult period. Here, this talk will share with all attendees the vision and experience of SOE about the internationalization for Graduate Education.

## **High-rate synthesis of nanoparticles using modulated induction thermal plasmas**

Prof. Yasunori Tanaka

*Faculty of Electrical, Information and Communication Engineering, Kanazawa University*

**Abstract:** We have developed a unique and original method to synthesize large amounts of nanoparticles (NPs) using the pulse-modulated induction thermal plasma (PMITP) with time-controlled feedstock feeding (TCFF). This method is called 'PMITP+TCFF' method. This PMITP+TCFF method is characterized by intermittent feedstock powder feeding synchronized with modulation of the coil current sustaining the PMITP. The synchronized feeding makes the feedstock powder be evaporated efficiently and completely in the plasma torch during high power period even under heavy-load condition, which generates high density atoms. In successive low power period, the high dense atoms are transported and rapidly cooled down downstream of the plasma torch. This rapid cool down of the high dense atoms promotes nucleation of nanoparticles. Actually, using this developed method we successfully synthesized TiO<sub>2</sub> NPs with a high production rate of 500 g/h, Al-ion doped TiO<sub>2</sub> NPs with 400 g/h, Fe-ion doped TiO<sub>2</sub> NPs with 800 g/h, and Si NPs with 120 g/h at 20 kW.

## **Wind energy harvesting from flow-induced transverse vibration of cantilevered cylinder and prisms using magnetostrictive material**

Prof. Takahiro Kiwata , and Dr. La Ode Ahmad Barata

*School of Mechanical Engineering, Kanazawa University*

**Abstract:** The flow-induced vibration by the wind combines with the magnetostrictive material, i.e., iron-gallium (Fe-Ga) alloy, to develop a vibration-power generator, which can generate electrical energy from a light wind. This new energy harvesting technology is expected to supply power to IoT devices as a substitute for batteries. The wind vibration-power generator is composed of a wind-receiving unit and a power-generating unit. We focus on transverse vortex-induced vibration for a circular cylinder, and low- and high-speed galloping vibrations for rectangular prisms. The purpose of the present study is to investigate the effects of span length and tip shape of models on the transverse flow-induced vibrations of cantilevered cylinder and prisms, and clarifies the most suitable shape of them.

The experiments were performed in a wind tunnel with a rectangular working section having a height of 1200 mm, a width of 300 mm, and a length of 2000 mm. The velocity  $U$  was changed from 1.0 m/s to 6.0 m/s. The reduced velocity  $V_r (= U/f_c H)$ , where  $f_c$  is the characteristic frequency of model) was varied from 1 to 12 by changing the wind velocity  $U$ . The test models were fabricated using a 3D printer and PLA resin filament. There were six kinds of test models, i.e., a circular cylinder, and rectangular prisms with a side ratio of  $D/H = 0.2, 0.3, 0.4, 0.5$  and 1 (where  $D$  is the depth of the prism in the flow direction and  $H$  is the height of models). The cross-sectional height  $H$  of all models was fixed to 40 mm. The span length of prisms  $L$  was changed from 200 mm to 400 mm. The maximum power generation of a short span cylinder is larger than that of a long span cylinder because the short span cylinder has a high characteristics frequency. However, the short span cylinder begins to generate power from a high wind velocity. Thus, the reduced velocity of vibration onset for all test models decreased with increasing span length. For the rectangular prisms with  $D/H = 0.2, 0.3$  and  $0.4$ , the characteristics of response amplitude is similar to that of the circular cylinder that is suddenly drop at high wind velocity. The highest power generation was 5.25mW at  $V_r = 3.25$  ( $U = 5.12$ ) for the rectangular prism with  $D/H = 0.4$ . For the rectangular prisms with  $D/H = 0.5$  and 1, the response amplitude increased with increasing the wind velocity. These cross-sections of prisms are not the suitable shape for the wind-receiving unit of the vibration-power generator. The cap of prisms has an influence on the characteristics frequency of the test model. The power for a circular cylinder with a span length of 200 mm at  $V_r = 6.45$  ( $U = 4.06$  m/s) becomes  $(P_{rms})_{max} = 2.87$  mW, which is larger than the other test models because the cylinder without a cap has a high characteristics frequency. After reaching the peak, the amplitude of the circular cylinder decreased, and the vibration ceased above  $V_r \approx 9$ . This phenomenon is useful in preventing the destruction of the vibration-power generator in strong wind.

## **Low-Carbon Fuel Production Via Gasification of Organic Solid Wastes Towards Carbon-Neutralization Target**

Assoc. Prof. ZHAO Ming

*Assist. Dean, School of Environment, Tsinghua University*

**Abstract:** China has been deeply involved in the global climate governance in recent years especially under the framework of Paris Agreement. As the biggest developing country, China has proposed the rather ambitious goals to reach carbon emission peak by 2030 and carbon neutralization by 2060. At the same time, China also placed huge investment in environmental pollution control and ecosystem remediation. It is wise to realize that mitigating carbon is luckily aligned well with pollution elimination. My person research interests have been motivated by this principle and focused on the solid waste control with maximized clean energy recycled. In China, the annual production of solid wastes has reach 6 billion tons, more than 60% of which are organic or biomass-based wastes (including ‘industrial biomass’). The carried energy roughly accounts to 1/4-1/3 of the annual coal consumption. Therefore, we trust effective treatment and energy refinery technologies could not only remediate the environment, but also markedly offset the unrenewable fossil fuels usage and the corresponding carbon emission. This talk will introduce some recent results from our group in the field of organic wastes gasification.

## **The influence of air flow rate on tar and gas production in biomass gasification: Experiments and modelling**

Assoc. Prof. Hiroshi Enomoto , and Zhaohe ZHOU  
*Graduate School of Natural Science and Technology, Kanazawa University*

**Abstract:** Biomass is being considered to play an increasingly important role in energy field. Gasification is one of the main methods for converting biomass into syngas. However, tar content in syngas limits its direct use and thus requires additional removal techniques.

The modelling of tar formation, conversion and destruction along a gasifier could give a wider understanding of the process and subsequently help in tar elimination and reduction. During biomass gasification, tar undergoes the process of generation, decomposition and reformation. However, tar complexity, which contains hundreds of species, makes the modelling process hard and computationally intensive. In this work, by summarising the pyrolysis reactions in previous literatures and calculating the thermodynamic data of biochemistry (cellulose, hemicellulose, and lignin) with Benson group increment theory, complete the kinetics file and thermodynamics file required for the simulation, as a dataset. With reference to the method of the Italian team, a method of predicting the composition of biomass through element analysis results was summarized.

The gasification simulation process mainly observes three tar species (benzene, naphthalene, phenol) and six main gas components (CO, CO<sub>2</sub>, H<sub>2</sub>O, H<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>)

The initial conditions of the experiment are 50L/min of air flow and under the two-stage combustion state, 40L/min of air flow and 10L/min of O<sub>2</sub>. The gasification process of Japanese cedar under this condition was simulated in CHEMKIN to analyse the generation of gas and tar.

The predictions of wood pyrolysis are crucial for finding the condition of reducing tar generation.

## **Recent status of ISO standardization in the field of water reuse in urban areas**

Assoc. Prof. Qianyuan WU

*Tsinghua Shenzhen International Graduate School, Tsinghua University*

**Abstract:** Water reuse is an important method to solve water shortage problem in the world. International Organization for Standardization (ISO) has established a sub-committee named “Water Reuse in Urban Areas” (ISO/TC 282/SC2). ISO/TC282/SC2 has published 4 ISO standards concerning design principle (ISO 20760-1) and management (ISO 20760-2) of a centralized water reuse system, water reuse safety evaluation parameters (ISO 20761). The standard named “Water reuse in urban areas— Guidelines for centralized water reuse system— Part 1: Design principle of a centralized water reuse system” (ISO 20760-1: 2018) provides system components, possible models and design principles of a centralized water reuse system. The standard named “Water reuse in urban areas— Guidelines for centralized water reuse system— Part 2: Management of a centralized water reuse system” provides principles and methodology of reclaimed water management, and management issues in each system component of a centralized water reuse system. The standard named “Water Reuse in Urban Areas— Guidelines for Water Reuse Safety Evaluation: Assessment Parameters and Methods” provides water reuse safety evaluation and public acceptance parameters and methods for users who design, manage, and/or oversee the non-potable water reuse schemes or activities in urban areas from the viewpoint of water quality. The working items under development and future plan of ISO/TC 282/SC2 will be introduced.

## **How biodegradable should a biodegradable plastic be?**

**Dr. Jaewook MYUNG**

*Korea Advanced Institute of Science and Technology*

**Abstract:** Biodegradable bioplastics are one of the fastest growing segments within the global plastics market, in wake of plastic pollution increasing around the world. Biodegradable bioplastics are not one single material but a large family of plastic materials, most of them very new innovative materials, with different properties and functionalities. The diversity of biodegradable bioplastics made it possible for this type of new materials being applied well beyond some of the original simple packaging applications to more sophisticated applications, including the manufacture of engineering components for extreme environments. But at the same time, the diversity and the ambiguity in the definition of biodegradability is an obstacle for the standardization of the specification of bioplastics, which is a critical basis for evaluating claims by individual market participants. Here, I present recent innovations to transform waste/wastewater into “truly” biodegradable plastics that can be a sustainable alternative to petroleum-based plastics, sequester carbon, and help address climate change. In addition, this bioproduct can also serve as a prebiotic fish/animal food that improves fish/animal health and enhances growth. Altogether, this strategy enables transition of waste/wastewater treatment facilities into resource recovery infrastructure enabling sustainable production of valuable bioproducts and low-cost treatment of waste.

## **Applications of Environmental Electrochemistry: Current Status and Perspectives**

**Dr. Kangwoo CHO**

*Korea Advanced Institute of Science and Technology*

**Abstract:** Current challenges on environment, water, and energy may be addressed with an efficient distribution of elements by redox transformation under general principles of electrochemistry. This presentation deals with variable research works of my group to address issues in environmental and energy science with the following subtopics 1) Wastewater electrolysis cell (WEC) for treatment of high-salinity wastewater: Field-scale WEC based toilet wastewater treatment system was demonstrated in connection with renewable energy for self-standing operation to provide sufficient effluent water quality for unrestricted urban reuse. The major oxidant, reactive chlorine species, could be further utilized for ammonium-rich industrial wastewater treatment based on electrochemical breakpoint chlorination. 2) Electrocatalysts development for application in water treatment: Chloride ion in wastewater can be oxidized to reactive chlorine species (RCS) such as free chlorine and chlorine radicals ( $\text{Cl}^\bullet$ ,  $\text{Cl}_2^\bullet$ ), as core mediator of environmental pollutants degradation. The surface selectivity towards wider array of environmental reactions can be controlled with material engineering. Representative examples of the heterojunction mixed metal oxides anodes include  $\text{Ir}_{0.7}\text{Ta}_{0.3}\text{O}_y/\text{Bi}_x\text{Ti}_{1-x}\text{O}_z$  architecture for a superior selectivity for RCS generation in dilute aqueous solution. The heterojunction architecture could be applicable to earth abundant electrocatalysts,  $\text{NiFe}_2\text{O}_4$  with or without partial doping (~ 5 %) of Ir. 3) Energy conversion and harvesting coupled with wastewater treatment: during the on-site wastewater treatment in WEC, partial recovery of energy was possible via cathodic reduction of water and proton (decentralized  $\text{H}_2$  production). Relatively low purity of  $\text{H}_2$  (~60%) might require a synergetic combination with anaerobic digester for blended fuel generation. A direct oxidation of organic pollutants (urea) might further boost the energy conversion efficiency in terms of urea electrolysis or urea fuel cell. 4) Electrochemical intensification of traditional wastewater treatment processes: Analogous electrolytic units have been deployed in order to boost the performances of biological wastewater treatment processes. For example, electroflotation was found to suit for clarification and thickening of activated sludge for flexible operation of biological nutrient removal processes. In addition, in-situ chlorination strategy effectively mitigated the fouling behavior of membrane bioreactors by reduction of extracellular polymeric substances.



## **Chemically enhanced primary sedimentation and acidogenic sludge fermentation for improved nutrient removal and resource recovery from municipal wastewater**

Dr. Lin LIN

*Tsinghua Shenzhen International Graduate School, Tsinghua University*

**Abstract:** In the age of environmental conservation and sustainable development, municipal wastewater has been regarded as a source of water, energy, fertilizer nutrients and other valuable materials, rather than a stream of waste flow. In this report, a new chemical-biological process has been developed to achieve effective energy-saving and resource recovery in municipal wastewater treatment. The new system utilizes iron and aluminium-based chemically enhanced primary sedimentation (CEPS) to concentrate organics and P into the sludge and hence reduce the pollutants load on the downstream treatment process. A side-stream module for acidogenic sludge fermentation was applied to convert wastes in CEPS sludge to valuable resources, including volatile fatty acids (VFAs) and nutrient fertilizers. After nutrients extraction by electro dialysis, the VFAs-rich sludge liquor was then used for denitrification in wastewater treatment. Mass balance and cost-benefit analysis showed that this innovative chemical-biological treatment system can achieve effective pollutant removal, energy-saving and resource recovery in municipal wastewater treatment, providing an environmentally-friendly process that will transform the current wastewater treatment practice into a resource-mining opportunity.

## **Measurement and prediction of annual mass flows of veterinary antibiotics in the Oyodo River**

**Dr. Seiya Hanamoto**

*Environment Preservation Center, Kanazawa University*

**Abstract:** Strategies for the management of livestock waste make surface runoff from agricultural land in Western countries and effluent discharge from livestock farms in Japan major pathways of entry of veterinary antibiotics into surface waters. We developed a model for predicting annual loads of veterinary antibiotics discharged into surface waters as effluent, using population, usage, excretion, removal, and fraction of livestock waste treated as wastewater. To verify the model, we monitored three veterinary antibiotics which are much used in Japan and are stable during river transport—i.e., sulfamonomethoxine (SMM), sulfamethoxazole (SMX), and lincomycin (LCM)—over a year in the Oyodo River, in whose catchment swine farming is most active in Japan. Concentrations and mass flows of SMM and SMX showed a sharp peak in winter, and those of LCM were also higher in winter than in summer in the river. Annual mass flows observed in the river were within a range of  $\frac{1}{2}$  to 2 times the model estimates. Effluent from swine farms contributed largely to mass flows of SMM and LCM in the river, while human wastewater from sewage treatment plants and households contributed partly to those of SMX. Our future work will include other locations and antibiotics.

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## **Removal of PFAS by RO membranes with different salt rejection ratios**

**Dr. Hiroe Hara-Yamamura**

*Faculty of Geosciences and Civil Engineering, Kanazawa University*

**Abstract:**

## **Analyses of the Road environments as a factor of inconvenience of store accessibility: Focusing on the preference and amounts of road elements on the route**

Dr. Tatsuya Sekiguchi

*Institute of Science and Engineering, Kanazawa University*

**Abstract:** The problem of grocery disadvantaged shoppers has become more serious in Japan. As numerous studies pointed out, having the inconvenience of store accessibility often causes the bad influence for nutrition intake and health. Therefore, the accessibility to the stores should be ensured by appropriate urban development. For elderly people who go shopping by walk, not only distance but also other road environments become factors of inconvenient. However, there are few study that focus the detail road elements.

In this study, it is assumed that dissatisfaction to various road elements can be a factor of inconvenience of accessibility. Focusing the individual evaluation, this study aims to clarify the 1) characteristics of dissatisfaction against each road element and 2) extract the elements as a factor of the inconvenience. The results contribute to making the road environment which is more comfortable for elderly shoppers.

A survey was conducted to the people who lives in Tokyo metropolis and go shopping by walk. In the analyses, firstly, the relationship between the dissatisfaction and the preference of each road element is analyzed. Secondly, we analyzed the characteristics of those who tend to avoid each element. Moreover, we extracted the elements that elderly people tend to feel dissatisfaction. We also analyzed the relationship between their dissatisfaction and the amount of each element on the route to stores. Finally, a regression analysis was conducted to extract the road elements that can become factors of the inconvenience of store accessibility.

## **Disaster drills as experiential learning system using mixed reality**

**Dr. Yuya Yamato**  
*Fukui College*

**Abstract:** When the fire in elementary school, evacuation action is important to escape. The emergency drill is designed to ensure that evacuation action is carried out as quickly and accurately. Generally, the emergency drill is more formalized, such as following a predefined route. However, many unexpected things occur in an actual fire. Therefore, the researchers aim to improve the quality of disaster drill and reduce the number of fire victims. In this research, we are developing a mixed reality (MR) based experiential disaster training system. The researchers reproduce a lot of things in a 3D model. For example, the situation of a fire, the smoke, the fire doors being closed, emergency exit guide lights, and so on. This research is unique in two points. Firstly, easy to cut labor costs and equipment costs. Secondly, it is easy to promote the fixation of evacuation action because we can experience a lot of situations by using MR. MR is easy to change the training scenario. If an emergency drill using MR is realized, we can reduce the cost of preparing for them, and we can suggest a new type of them which is using MR. When this plan turns out well, we can make a broad social and academic contribution.

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## **Study on optimum asphalt content for recycled-plastic road in Phnom Penh Phanny Yos Khmer**

Dr. Yos Phanny  
*Institute of Technology of Cambodia*

**Abstract:**

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## **Development of home solar dryer for drying of finish in Cambodia**

Dr. Kinnalesh Vongchanh  
*Institute of Technology of Cambodia*

**Abstract:**

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**The Improvement of Solid Waste Management  
System of Tourism Area by Life Cycle Assessment  
Approach in Supporting the Sustainable Tourism  
Development**

Dr. Rizki Aziz  
*Andalas University*

**Abstract:**



## **Efficient and Stable Perovskite Solar Cells using Ionic Liquid Assisted-MAPbI<sub>3</sub> Nanoparticle-Seeded Growth Approach**

Md. Shahiduzzaman, and Tetsuya Taima  
*Nanomaterials Research Institute, Kanazawa University*

**Abstract:** With the rapid improvement of perovskite solar cells (PSCs), long-term operational stability has become a major concern for their commercialization. In this work, we devised a pristine cesium-formamidinium-methylammonium (termed as CsFAMA) triple cation-based perovskite precursor solution into the ionic liquid (IL)-assisted MAPbI<sub>3</sub> nanoparticles (NPs) through a seeded growth approach in which host IL-assisted MAPbI<sub>3</sub> NPs remarkably promoted high-quality perovskite films with large grains and high crystallinity, enhancing device performance and stability. The power conversion efficiencies (PCEs) of the MAPbI<sub>3</sub> NP-seeding growth of MAPbI<sub>3</sub> NPs/CsFAMA-based PSCs were as high as 19.44%, which was superior to those of MAPbI<sub>3</sub> NPs and pristine CsFAMA film as the photoactive layer (9.52% and 17.33%, respectively). The long-term light-soaking and moisture stability of IL-aided MAPbI<sub>3</sub> NPs/CsFAMA-based devices (non-encapsulated) remained above 90% and 80%, respectively, of their initial output after 2 h of light illumination (1 Sun) and 6000 h storage in open air with a relative humidity range of 30%–40%. The use of IL-assisted MAPbI<sub>3</sub> NP-seeded growth for PSCs is a significant step toward developing reliable perovskite photovoltaic devices.



**Pararall session** ■  
Spatial Planning and  
Sustainable Development

## **Overview from Historical Wisdom to Modern Miracles: Experience from Chinese Urban Planning and Practices**

Assoc. Prof. Yan TANG  
*Tsinghua University*

**Abstract:** The capital region of Beijing-Tianjin-Hebei (BTH) has developed disproportionately over the past four decades, since Beijing and Tianjin have absorbed most of the regional investments, resources and talents for being the capital or the national central cities. However, the emerging “mega-city diseases” of Beijing caused by high densities of urban functions and populations, such as heavy air pollution, water resource shortage, serious traffic jams and continuous environmental deterioration, have forced the state government to continue exploring a more sustainable approach to promote the eco-friendly development of Beijing, as well as the wider BTH region. The national strategies of decentralizing the non-capital functions of Beijing and promoting the coordinative development of BTH region have been launched. Among them, the decision to construct Tongzhou, the Sub-City Center of Beijing, and the Xiong’an New Area, a new magnetic development center in Hebei province, are the two most significant actions. Based on literature review and policy analysis, this chapter first summarizes the evolution trend from “concentration” to “decentralization” of Beijing and the BTH region during the past decades, and then illustrates the main recent decentralization measures aiming at controlling the population and functions of Beijing from four spatial levels: the BTH region, the Beijing administrative region, the Beijing central city and the community level. The prospect of the decentralization strategy is further discussed in the conclusion and discussion.

## **'Regional Design' of the Ancient Chinese Capitals: A Case Study of Chang'an in Tang Dynasty**

Dr. Lu GUO  
*Tsinghua University*

**Abstract:** Ancient Chinese Cities are highly integrated with and closely related to the extramural area. The planning and design of the capital was not restricted to the area within the city wall; rather it was extended to the surrounding areas. 'Regional Design' was implemented in the whole capital region to meet the functional needs of the capital and create a grand spatial image. There has been plenty of research on the urban planning and design of Chang'an in Tang Dynasty (618-907), which is the capital of the most prosperous dynasty of ancient China. However, little research has paid attention to its planning and design at the regional scale. This article aims to solve this problem using the 'triple-evidence' method. The 'Regional Design' of Chang'an would be expounded from two aspects: (1) Functional Layout. The layout of the capital function was carried out at the scale of the Guanzhong Basin, forming several functional circles. (2) Spatial Structure. Regional-scale axes connecting the city and the natural mountain was established to form a spatial backbone, and the high points with good view of the natural terrain were occupied to build important buildings forming several controlling "belts" of the regional space. The spatial law and the implementing subjects of regional design in ancient Chinese capital area would be discussed as a conclusion.

## **Looking into the Supergrid and Superblock Structure in Chinese Cities: Taking Xi'an and Nanjing as Examples**

Dr. Xiaofei CHEN  
*Qingdao University of Technology*

**Abstract:** Supergrid is a large-scale network of wide roads that defines a series of cells as Superblocks. Uniquely in China, each Superblock contains a number of walled living quarters next to each other assisted with a few narrow streets to minimize through traffic. Together, they make a Global-local transportation system as one of the most predominant city skeletons of modern Chinese cities. While Barcelona's planning movement has been converting street blocks to Superblocks since the 1990s, the State Council of China released a set of planning guidelines in 2016 and suggests the opposite: transforming the current Super grid-and-block structure to a finer network by disassembling existing gated communities within Superblocks. This was strongly opposed by the people, who emphasize the importance of the wall to their safety. Such conflict between the policy and people's reaction reveals a lack of understanding of the structure in Chinese social and planning context. This chapter provides a comprehensive exploration of the development of the Superblock structure in Chinese planning history and elaborates the modern planning practice by examining one of each Superblocks from Xi'an and Nanjing as case studies. Through investigation, this chapter points out that the use of Superblocks in combination with walls and gates around living quarters is a unique Chinese spatial planning logic despite the influence of modern western planning ideas. It is important to rethink the applicability of the proposed guidelines and incorporate the traditional planning concept in modern city design.

## **Adaptive Resilience: Traditional Wisdom of the Mulan Weir Water Conservancy System in Song-Yuan Period**

Prof. Tianjie ZHANG  
*Tianjin university*

**Abstract:** The Mulan Weir in southeast China, a World Heritage Irrigation Structure, has been serving for nearly one thousand years. It can adapt to natural disasters such as drought, floods and tides, ensuring regular agricultural irrigation. Through in-depth literature review, this chapter presents a framework for resilience analysis involving ecological, engineering, social and economic subsystems. Following this framework, the research reveals the traditional wisdom of adaptive resilience in planning, construction and management of the Mulan Weir system.

On the basis of archival research and fieldworks, the study finds out the ecosystem of the Mulan River basin was in a relative dynamic balance during Song-Yuan Period. The water conservancy system included three levels, and consisted of weirs, sluice gates and culverts. It subtly improved the local irrigation conditions and was flexible enough to adapt to different disaster scenarios. What's more, local social organizations and folk beliefs promoted self-organization and ensured the construction and maintenance of engineering facilities. The economic strategies further provided long-term momentum.

The research uncovers that the adaptive resilience of this outstanding ancient project depended not only on advanced engineering design, but also on the interaction and application of different subsystems. Active social organizations, engaging cultural atmosphere and flexible economic strategies all contributed to the adaptive resilience. They guaranteed the daily and also long-term maintenance of engineering facilities. Even in the face of disasters, these characteristics ensured faster recovery of the entire system.

## Three Stages of Urban Community Development and Regeneration Planning in Chongqing

Prof. Ling HUANG  
*Chongqing University*

**Abstract:** Around 2010, the Chongqing city has shifted its focus from urbanization rate growth to quality improvement after the urbanization rate exceeded 50%. Urban planners began to pay more attention to community-based interventions within the city context that called for a better quality of life and people-oriented new-type urbanization. Many theories and approaches have been tried and conducted by urban planners to meet the resident's needs and to solve social problems in local community programs. This paper characterizes and reviews multidisciplinary approaches to community planning in the Chongqing city for the past ten years. The process can be divided into three stages. In the Germination stage (2010-2013), community development was mainly based on the construction of community neighbourhood committees. The continuous declines of quality of the physical environment of the older communities have a tremendous negative impact on residents' daily life, which later became a major social problem at that time. The planning aimed to improve the community's built environment by identifying and recognizing its cultural assets and promoting its environmental renovation with the strategy of a cultural renaissance. In the Rising stage (2013-2016), the planner tried to incorporate innovative social governance into the community's regeneration program, with the context that social governance was a part of national governance in China in 2014. Using the Asset-based Community Development (ABCD) approach, all community resources could be looked at as community assets and could be identified as the community's human assets, social assets, and physical assets. The whole planning process was divided into built environmental regeneration and community governance. The project finally got the following achievements: (1) it developed community action plans; (2) it gained broad-based community participation. The project showed that the community planning of Chongqing had expanded its content from the physical environment renewal towards comprehensive social planning. In the Developing stage (2016 onwards), the demands and contradictions of community development have become increasingly complex and diverse, and the ABCD approach has been used with several community regeneration practices with various social-economic conditions. With the involvement of the ABCD approach, the goal of community diversification development can be achieved. The internal force of a community can be further stimulated, and the relationship between community development and planning can be further strengthened. The significance of this paper is to present the process of community development in Chongqing for the last ten years, which enables planners and policymakers to recognize the critical roles that communities play in urban development and the roles residents play in community planning. In the next decade of Chongqing's community development, it is necessary to adopt ABCD to highlight the locality and diversity of community planning. More importantly, the community governance framework needs further exploration and improvement. It will be a new opportunity and challenge for Chongqing.

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## **Green Low-carbon High-density Urban Center Planning Wuhan Wangjiadun area**

Prof. Xu SHEN

*Huazhong University of Science and Technology*

**Abstract:** High-density urban centers have provided a concentrated space for politics, economy, culture and service, yet have also brought many problems. From the perspective of green low carbon planning, this chapter summarizes the experiences and lessons of planning and construction of typical urban centers around the world, and proposes three aspects of high-density urban centers' planning and construction: municipal planning, transportation planning and building energy planning. Taking the high-density urban center – Wuhan Wangjiadun Central Business District (CBD) as an example, the specific strategies regarding green low-carbon planning are proposed. The chapter aims to analyze the achievements of planning and construction of Wuhan Wangjiadun CBD, and offers suggestions and instructions on the planning, development and construction of high-density urban centers in China, from the perspective of green and low carbon planning.



## **Towards a Sustainable City: A Scoping Review of Eco-cities development and practices in China**

Dr.Cai ZHI  
*Tsinghua University*

**Abstract:** With the rapid development of urbanization, China is facing many challenges on environmental problems, such as air pollution, water deterioration and urban heat island effect. To cope with the urban ecological crisis, China has paid more attention to eco-city construction. This chapter traces the origin of eco-city concept at the first part, and then reviews the development of eco-cities in China, in which several typical eco-cities have been taken as case studies to illustrate the practices of eco-city construction. The results showed that there are three periods of eco-city practice development in China: eco-cities (1990s), low-carbon cities (2000s) and smart-eco cities (2010s). In the period of eco-cities, the focus was paid on ecological and environmental issues, and the concept of “harmony between humans and nature” was widely applied to guide eco-city construction. In the period of low-carbon cities, attention was paid to cutting greenhouse gas emissions amid the severe domestic environmental situation and international societal pressure. In the new trend of smart-eco city construction, great importance has been attached to the city with green and ecological concepts, trying to combine the eco-cities with smart technologies. It is worth noting that the eco-city construction in China has always led by the central government and acted as a top-down approach, which also caused some problems among the practices.

## Healthy City Planning: Insights from China

Prof. Lan WANG  
*Tongji University*

**Abstract:** City planning, a major means for the allocation of resources and shaping of urban space, is an authoritative guide for the promotion of public health. Healthy city planning is considered one of the most important instruments for building a 'Healthy City', which is an important concept proposed by the World Health Organisation (WHO). This chapter elaborates on the development progress of healthy city, the research progress of healthy city planning, and the theoretical exploration and practical experience in China. We propose both theoretical and practical frameworks for healthy city planning and investigate the potential capacity of health impact assessment (HIA) as a policy tool to integrate health into city planning. It is concluded with the challenges and experiences of research, and the practice of healthy city planning in China, aiming to shed light on the important principles in developing a healthy city in different contexts across the world.

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## **From Green Building to Green City——The Practice in Jiangsu Province, China**

Mr.Dengyun WANG

*Jiangsu Provincial Department of Housing and Urban-Rural Development*

**Abstract:** This article focuses on Jiangsu's experience in promoting green buildings and green eco-city, including green ecological special planning, policy mechanisms, fundraising, technical standards systems, and promotion. Taking the demonstration zones of Nanjing Hexi New Town as an example, the practical experience of the demonstration area in special planning guidance, policy mechanism formulation, green building development, and urban green infrastructure construction was introduced. This not only has great reference significance for the development of China's new cities but also has certain reference significance for the development of new cities in the world and the renewal of old cities.

## **New Countryside in the Internet Age: The Development and Planning of E-commerce Taobao Villages in China**

Prof. Zhendong LUO  
*Nanjing University*

**Abstract:** With the progress of economic globalization and Internet informatization, Taobao Village become a special economic geographic phenomenon in Chinese rural region. Through analysis of the spatial distribution data of Taobao Villages from 2014 to 2018, this chapter points out that the spatial distribution of Chinese Taobao Villages shows a longitudinal “North-Middle-South” agglomeration structure and a latitudinal “East-Middle-West” diffusion trend, and a rapid fissile proliferation among Taobao Village industry clusters. In the Yangtze River Delta region, three major Taobao Village agglomeration areas are located in the “double-marginal” zone, that is, the urban margin and the margin of the metropolitan area. Then propose a “diamond model” to explain the formative mechanism of Taobao Villages, in which grassroots entrepreneurs, main products, facilities support and governments support constitute the four key factors, and the village Party branch and village committee are the main agents for Taobao Villages to transform the rural governance pattern and accomplish beautiful village construction. In order to cope with the disorder of built environment which caused by weak regulation, the planning and construction of Taobao Villages should focus on the bottom-up and implementation-oriented construction of rural living environment.

## **Innovation Districts in Beijing: Evolution, Distribution, and Development Mechanisms**

Dr. Xiaohui YUAN

*Shenzhen Quant Urban Technology Co. Ltd.*

**Abstract:** Suzhou experienced fast economic growth in the past 30 years, which was accompanied by dramatic urban growth. During this process, the society benefitted from the economic boom and faced tough challenges and choices associated with diminishing land resources and environmental deterioration. By analysing a wide range of literature, aerial maps and statistical data, and through interviews with scholars, government officials, stakeholders, this article traces the industrialization and urbanization process in Suzhou from 1984 to 2008 (between the Chinese Reform and Opening-up Policy and the World Financial Crisis, and also before XI Jinping's New Era). This analysis reveals how a pro-growth coalition involving state and market powers formed a "Growth Machine," which accelerated socio-economic changes. Because Suzhou is one of the fastest growing cities in China, other cities experiencing similar "Growth Machine" effects can gain insights regarding the implications of these strategies for community development and the evolution of urban form.

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## **Suzhou’s “Growth Machine”: Tracking the Driving Force behind a Fast Growing Chinese Urban Region**

Prof. Yifan YANG

*China Architecture Design and Research Group*

**Abstract:** Suzhou experienced fast economic growth in the past 30 years, which was accompanied by dramatic urban growth. During this process, the society benefitted from the economic boom and faced tough challenges and choices associated with diminishing land resources and environmental deterioration. By analysing a wide range of literature, aerial maps and statistical data, and through interviews with scholars, government officials, stakeholders, this article traces the industrialization and urbanization process in Suzhou from 1984 to 2008 (between the Chinese Reform and Opening-up Policy and the World Financial Crisis, and also before XI Jinping’s New Era). This analysis reveals how a pro-growth coalition involving state and market powers formed a “Growth Machine,” which accelerated socio-economic changes. Because Suzhou is one of the fastest growing cities in China, other cities experiencing similar “Growth Machine” effects can gain insights regarding the implications of these strategies for community development and the evolution of urban form.

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