NEWSLETTER

Issue 4
December 2019

SJTU-APGI Unveiling Ceremony

Shanghai Jiao Tong University Asia-Pacific Graduate Institute (SJTU-APGI) held the unveiling ceremony on 28th Nov at CREATE Tower. Mr Hong Xiaoyong, Chinese ambassador to Singapore and Prof Jiang Sixian, SJTU Party Secretary and Chairman of University Council jointly inaugurated SJTU -APGI.

Mr Ong Ye Kung, Minister for Education sent a congratulatory letter on the occasion in hopes of enhancing collaborations between the two countries on the education.

The ultimate goal of SJTU-APGI is to promote the innovation of systems and integration of resources, and in turn, open up new global prospects in the fields of education and research.

Prof Jiang Sixian and Mr Hong Xiaoyong jointly unveiled the SJTU-AGPI

CREATE Symposium

Researchers presented E2S2 research projects to Ho Ching, Chief Executive Officer of Temasek Holdings

The CREAET Symposium was held on 6th Dec with the theme of Climate Change. A series of presentations/ panel discussions were presented in three sub-themes: (1) Mitigation, (2) Adapting to Climate change and (3) Policy and Planning.

E2S2 was honored to take part in the symposium to show the visitors our achievement, the current progress and the research direction. Visitors were impressed by the video presentation of Gasification and Anaerobic Digestion.

Lab Safety

Personal Protective Equipment — Gloves

Gloves should be worn whenever handling hazardous materials, even in small quantities. A few key characteristics to look for when selecting a glove include:

Type: Must be able to protect against the target contaminants such as chemicals, acids, biological, materials, heat, cryogenic fluid etc.

Comfort: Do the gloves offer tactile sensitivity and good grip? Glove material can have a dramatic impact on comfort.
Quality: Are the gloves strong enough to withstand the work conditions in your lab?
Fit: Gloves that are too small are more likely to rip, exposing users to contamination. If a gloves are too large, it can inhibit dexterity.

The people behind E2S2 and their contributions.

Dr Tian Hailin

Dr. Tian Hailin graduated from Department of Environmental Engineering, Technical University of Denmark (DTU) in December 2018, and then he joined E2S2-CREATE Program as a Research Fellow. His researches focus on the development of sustainable solutions for agro-industrial waste and urban organic waste, particularly on the control and optimization of anaerobic digestion processes, the anaerobic microbial ecology, the anaerobic reactor configuration design, and the sustainability evaluation of different waste disposal technologies through life cycle assessment and techno-economic analysis.

Under E2S2-CREATE Program, his main position is related to "ES-1, Waste Challenge A: food waste, sub-project 3: life cycle analysis on different strategies of waste management". He analyses the environmental impacts of the technologies (mainly anaerobic digestion and gasification) developed by E2S2 colleagues and help to optimize the technologies. Recently, his work showed that food waste disposal through E2S2 Mobile Solar Hybrid Anaerobic Digester can avoid greenhouse gas (GHG) emissions four times higher compared to the current incineration scenario, which highlighted the environmental benefits of E2S2 technology. Moreover, his recent publication also indicated that the gasification waste can be used to synthesis high-purity V_2O_5 in a greener way compared to the traditional mining processes. Additionally, he reviewed more than 200 articles about waste-to-hydrogen through biological fermentation, thermochemical gasification and microbial electrolysis cell, etc., and the results demonstrated the environmental advantages of gasification. However, the results also showed that high-quality LCA studies of waste-to-hydrogen are still lacking and recommended for future

The major publications in 2019:

[1] **Tian H**, Li J, Yan M, Tong YW, Wang C-H, Wang X. Organic waste to biohydrogen: A critical review from technological development and environmental impact analysis perspective. Applied Energy. **2019**; 256: 113961.

[2] **Tian H**, Wang X, Tong Y. Sustainability Assessment: Focusing on different technologies recovering energy from waste. (Book chapter)

[3] Li H, **Tian H**, Chang T-H, Zhang J, Koh SN, Wang X, et al. High-Purity V2O5 Nanosheets Synthesized from Gasification Waste: Flexible Energy Storage Devices and Environmental Assessment. ACS Sustainable Chemistry & Engineering. **2019**; 7: 12474-84.

[4] **Tian H**, Yan M, Treu L, Angelidaki I, Fotidis IA. Hydrogenotrophic methanogens are the key for a successful bioaugmentation to alleviate ammonia inhibition in thermophilic anaerobic digesters. Bioresource Technology. **2019**; 293: 122070.

[5] **Tian H**, Treu L, Konstantopoulos K, Fotidis IA, Angelidaki I. 16s rRNA gene sequencing and radioisotopic analysis reveal the composition of ammonia acclimatized methanogenic consortia. Bioresource Technology. **2019**; 272: 54-62.

[6] **Tian H**, Mancini E, Treu L, Angelidaki I, Fotidis IA. Bioaugmentation strategy for overcoming ammonia inhibition during biomethanation of a protein-rich substrate. Chemosphere. **2019**; 231: 415-22.

[7] Yan M, Fotidis IA, **Tian H**, Khoshnevisan B, Treu L, Tsapekos P, et al. Acclimatization contributes to stable anaerobic digestion of organic fraction of municipal solid waste under extreme ammonia levels: Focusing on microbial community dynamics. Bioresource Technology. **2019**; 286: 121376.

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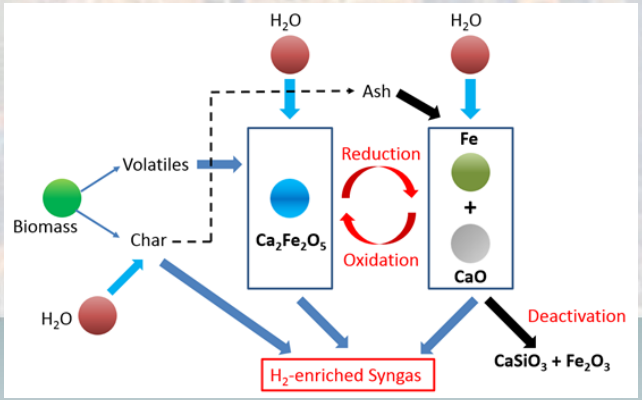
The people behind E2S2 and their contributions.

Dr Hu Qiang

Dr. Hu Qiang as a research fellow joint NUS from the Aug. 2018. Before that, he received his B.S and Ph.D in thermal engineering from Huazhong University of Science & Technology. His research interests mainly focused on gasification and chemical looping gasification for biomass or solid waste conversion and utilization.

From Aug. 2018 to Jul. 2019, Dr. Hu worked on the Intra-CREATE program collaborated between E2S2 and CARES Cambridge which focused on chemical looping process. He developed a bimetallic Fe-Ca oxide as the oxygen carriers to promote the hydrogen production from the chemical looping gasification of biomass. Effects of steam and OC, Fe/Ca ratio, and temperature were studied in relation to the hydrogen yield, solid structure evolution, and stability of OC to optimize the conversion conditions for the CLG process. A further deactivation mechanism was illustrated for the OC of Fe_2O_3/CaO to have a deep knowledge for the structure evolution behavior of $Ca_2Fe_2O_5$ in biomass-derived CLG process.

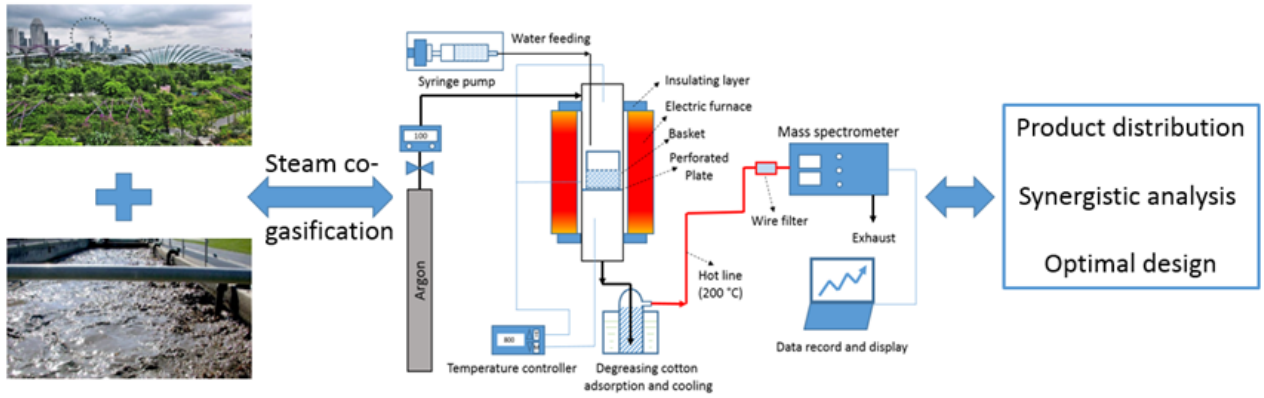


Furthermore, a novel Ca-Fe-O chemical looping system by integrating the Ca-based and Fe-based looping materials which provide both oxygen transfer and CO_2 transfer was firstly proposed for biomass conversion. Results explained that the integrated Ca-based and Fe-based chemical looping processes are expected to address versatile and effective technologies for biomass utilization.

And from Aug. 2019 to now, Dr. Hu moved on to E2S2-CREATE Program to study the high efficient gasification technology for syngas or hydrogen enriched syngas production. He investigated the steam co-gasification of horticultural waste (HW) and sewage sludge (SS) with different mass ratios under different temperatures. The product distribution, gas synergistic interaction, and optimal design for gas products from co-gasification process were carried out for a better understanding of the co-gasification process. Syngas yield and H_2 production were largely promoted by synergistic interaction at higher temperature due to the catalytic effect of Na and the reduction and steam oxidation of Fe species during co-gasification process. It indicates that steam co-gasification of HW and SS is a promising technology to produce desired syngas towards a clean and efficient waste management process.

The people behind E2S2 and their contributions.

Dr Hu Qiang



Recently outcomes related to E2S2-CREATE programme are summarized below:

(1) Hu Q., Shen Y., Chew J. W., Ge T., & Wang CH. (2020). Chemical looping gasification of biomass with Fe2O3/CaO as the oxygen carrier for hydrogen-enriched syngas production. Chemical Engineering Journal, 379, 122346.

(2) Zhang J.[1], Hu Q.[1], Qu Y., Dai Y., He Y., Wang CH., & Tong YW. (2020). Integrating food waste sorting system with anaerobic digestion and gasification for hydrogen and methane co-production. Applied Energy, 257, 113988. (Co-first author)

(3) Hu Q., Wang CH., et al (2020). Integration of the Ca-based and Fe-based oxides for chemical looping conversion of biomass. Proceedings of the Combustion Institute, Under review.

(4) Hu Q., Dai Y., Wang CH., et al (2020). Steam co-gasification of horticultural waste and sewage sludge: Product distribution, synergistic analysis and optimization. Bioresource Technology, Under review.

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