- ISSUE 19 -

June 2021

NEWRI update

Get up to date with NEWRI

A word from the Executive Director

Dear **Friends, Colleagues, and NEWRI Enthusiasts**:

We are now halfway through the 2021 calendar year, and sadly, we continue to suffer with the COVID pandemic. This especially true of our friends, family, and colleagues in South Asia where COVID has taken an incredibly tragic toll over the past weeks. While Singapore has seen some increase in community cases, NEWRI continues to be diligent in practicing all safety measures while continuing to make outstanding progress on our research and teaching endeavors.

We have enjoyed participating in a plethora of international meetings and engaged in multiple discussions with various local and international companies regarding research collaborations.

While a majority most of our meetings remained virtual, we were able to have several in- person visits which reminded us all how important human interactions can be. Let’s hope that 2022 brings great improvements in coping with the pandemic and higher degree of vaccinations that offer promise of increased face to face meetings in the “non-virtual” world.

NEWRI has successfully been awarded our tranche-3 (TR3) extension grant, which will continue until the end of September of this year. In addition to pro-rated funding to support our research programs, NEWRI also received significant funding to replace and/or upgrade our equipment. In this newsletter, be introduced to some of NEWRI’s capabilities, which including high-resolution mass spectrometry with unique capabilities for environmental and material characterization.

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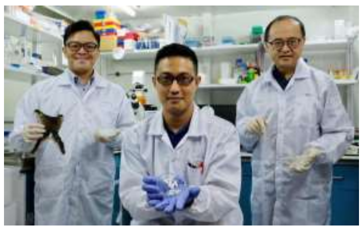

biomaterial to help in bone repair making it a cheaper and less painful process

Aquaculture waste can be converted into green chemicals and materials to help reduce environmental contamination. (Pg 4)

Team develops portable device that creates 3D images of skin in 10 minutes

Device enhances the diagnosis and treatment of skin conditions and injuries. (Pg 5)

Biocoke Utilization at Shaft-Type Gasifying and Direct Melting Furnace in Singapore

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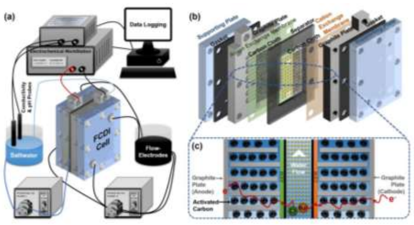

Flow-electrode capacitive deionization systems for selective resources recovery

Approach to achieve simultaneous desalination and fractionation of wastewater (Pg 7)

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Talking Point speaks with Prof Shane finds out about the consequences of chloromine in our swimming waters (Pg 3)

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A word from the Executive Director

NEWRI also has expanded its bioassay capabilities, adding several new platforms for toxicity screening and environmental characterization. We have also increased our technology platform for COVID and other pathogen monitoring, including the latest generation of genomic and proteomic equipment. To this end, we were particularly grateful that Singapore PUB has extended our research project on COVID wastewater monitoring and water treatment efficacy research grant. This project has been extremely successful and the NEWRI team is working with Singapore PUB to publish our most novel and impactful findings. We also enjoyed a collaboration with Trojan UV technologies whereby we evaluated corona virus disinfection using Trojan UV systems. We are particularly amazed by the resilience of the corona virus PCR detection after relatively high UV doses; however, our team also conducted viability testing for the virus which showed the virus was no longer infective at far lower UV doses. The same finding was true for chlorination and ozonation, thus, we learned that PCR (genetic) data alone is relatively poor predictor of disinfection. However, this work is but one example of the many projects that are underway at NEWRI.

We are also developing water treatment solutions for difficult industrial wastewaters through collaborative partnerships with local companies. Our unique treatment train allows a highly compact footprint yet with an extremely efficient and flexible process train that can tackle a wide array of challenging industrial waters. We have also engaged with several companies on solid-waste treatment and upcycling projects. In fact, it seems that our research in solid-waste and circular economy themes is beginning to outpace research in the strictly water domain. Our team has successfully developed a new process for sequestering carbon dioxide in flue gas by combining it with the wastes brine stream from desalination. The NEWRI team continues to expand its scope in food waste solutions, including the possibility of using food waste to create biogas for powering vehicles and for potential use in development of biodegradable plastics. Our material science experts are hard at work looking at expanded uses of incinerator bottom ash and fly ash, for instance, as potentially valuable catalyst materials for a variety of application and for building materials in construction.

Recently, I have come to appreciate the value of sand in Southeast Asia, where challenges are met in securing an ample supply of sand to continue land reclamation and construction. NEWRI's waste to energy research facility (WTERF) uses a gasification technology from JFE Corporation (Japan) to convert mixed solid waste into energy and into a metal slag that can be used in place of sand. This is lovingly considered a form of "NEWsand" as it is a similar waste to resource proposition just as in Singapore's widely known NEWater.

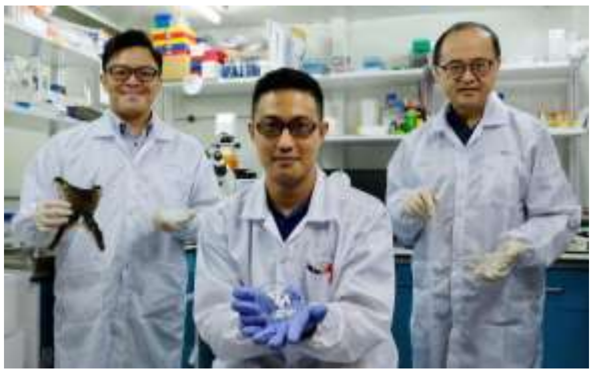
Lastly, I worked closely with our experts in resource recovery to disseminate our technological breakthroughs is plastic waste upcycling. NEWRI already has successfully developed technology that can convert mixed plastic waste into oil (NEWoil) and into carbon nanotubes, the latter presents a favourable business case that is drawing a large amount of commercial interest. These are just a few of the areas of exploration where NEWRI has made significant breakthroughs and impact. In this newsletter, you can learn of additional projects and research areas where NEWRI continues to expand and move the needle forward.

On the philanthropic front, NEWRI remains dedicated to our Lien Environmental Fellow (LEF) program. We continue to ship supplies to Nepal, Thailand, and Myanmar where our projects are already underway, while we also consider applications for new projects within an expanded geography. Over the past months, I had the opportunity to meet with both the CEO of the Lien Foundation (Lee Poh Wah) and with Laurence Lien from Asian Philanthropic Circle. Despite all the setbacks and limitations that COVID has brought, we continue to push forward in our mission to increase access to safe and sustainable water and to improve sanitation and environmental conditions for underserved communities. However, all of us realize that the turmoil in Myanmar has made some of efforts in that region more difficult. Indeed, our hearts go out to all our friends and colleagues in Myanmar who are struggling not only with COVID, but also political unrest. NEWRI remains appreciative of the opportunities to improve conditions with millions of people through education and technology interventions. Over the past year, NEWRI has deployed nanofiltration (NF) technology to Mandalay, Myanmar and is in the process of deploying a silicon carbide inorganic membrane filtration system in Chiang Rai, Thailand. NEWRI believes strongly in deploying the best available technologies to those who have the greatest need. We thank again the Lien family and foundation for their continued trust and support during these challenging times.

As stated in my last editorial in the previous newsletter, NEWRI is about to enter our fourth tranche of funding (TR4). Clearly, the NEWRI team, including our students, staff, and faculty have done incredibly well over the past years. As of today, we have achieved and exceeded all KPIs, a feat that was concerning when I joined three years ago. Indeed, the Singapore government and NTU provide NEWRI with abundant resources, but those resources are met with objectives to multiply these resources with external funding, predominantly private sector funding. This is not at all an easy task, and it has been possible only by working as a united team with an extraordinary diversity of talents and cultures. And of course, this comes with challenges that must be met head-on and resolved through fact finding with creative problem solving. I am very proud of the NEWRI team and I feel very fortunate to be the leader of such an incredibly talented and diverse group of people. As we evolve into TR4, you will see NEWRI even more united as we tackle some of Singapore's and the world's most daunting environmental challenges.
Thus, we enter into the next five years of NEWRI, expect exciting new developments that increase inclusivity and diversity. With the next tranche of NEWRI funding secured, we can begin the process of better aligning NEWRI with our stakeholder needs, which are predominantly the national needs of Singapore. Concurrently, we look forward to continued and new collaborations with our various industrial and academic partners. We also look forward to new philanthropic endeavors with even more generous stakeholders. While it is clear the pandemic is far from over, there is hope with the steadily increasing vaccination rates and vastly improved capabilities for tracing the potential outbreaks. I am very pleased to be leading NEWRI into the next five years of research, engineering, and deployment and look forward to working with all of you who make this journey possible.

Sincerely,
Shane A. Snyder

NTU scientists develop biomaterial to help in bone repair making it a cheaper and less painful process



(From left) NTU Assistant Professor Dalton Tay, NTU research fellow Dr Wang Jun Kit, and NTU Prof Matthew Hu Xiao are part of the research team that developed the new biomaterial.PHOTO: NTU SINGAPORE (May 2021)

Click here to go to write up

Bone repair often requires additional surgery to extract a patient's own tissue, but scientists at the Nanyang Technological University (NTU) have developed a biomaterial that could help make it a cheaper and less painful process.

And they are making the material from frog skin and fish scales, which are usually discarded by farms. **Professor Matthew Hu Xiao,** co-author of the study and director of the Environmental Chemistry and Materials Centre at NEWRI, said that aquaculture waste can also be converted into green chemicals and materials to help reduce environmental contamination.

The porous biomaterial acts as a scaffold for bone-forming cells to adhere to and multiply, leading to the formation of new bone, helping the regeneration of bone tissue lost to disease or injury, such as jaw defects from trauma or cancer surgery.

NTU Singapore team develops portable device that creates 3D images of skin in 10 minutes

The article appeared first in The Straits Times and other platforms
(Press released 2 Feb 2021)

For links to articles, please click here

A team from the Nanyang Technological University (NTU) has developed a portable device that can create 3D images of the skin within minutes, which will enhance the diagnosis and treatment of skin conditions and injuries. The battery-operated device weighs 100g and creates 3D maps of skin within 10 minutes. It costs $30 to make and is reusable.

Assistant Professor Grzegorz Lisak from NTU's School of Civil and Environmental Engineering, who led the research, said that substances used in the film are not toxic to the skin and it would only be used on wounds that are no longer bleeding.

Prof Lisak said: "*The next step is to go for clinical trials which will be attempted this year, where we can have a bigger pool of subjects to further validate the usefulness of this technology*".

JFE to Demonstrate Biocoke Utilization at Shaft-Type Gasifying and Direct Melting Furnace in Singapore

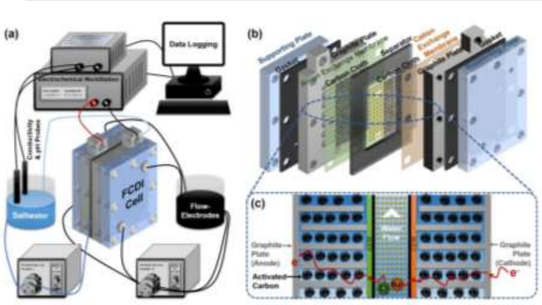
Source and photo: JFE
(press released 3 Mar 2021)

For the press release, please click here.

JFE Engineering Corporation will conduct a demonstration project utilizing Biocoke as a fuel in its Shaft-Type Gasifying and Direct Melting Furnace beginning in May 2021 in collaboration with Nanyang Technological University, Singapore (NTU) and Kinki University (Kindai) in Japan.

In Singapore, significant amounts of waste biomass such as wood waste, sawdust, and biomass from sewage sludge are generated.

This research project will attempt to harness these resources in the form of Biocoke as part of the ongoing global effort to develop technologies for the utilization of waste biomass.



Flow-electrode capacitive deionization systems for the selective recovery of resources from wastewater

An electrochemical approach to achieve simultaneous desalination and fractionation of wastewater based on the permselectivity and the size exclusion effect of ion-exchange membranes (IEMs).

Click here to go to article

CNA's Talking Point: 'What's really in our pools?'

Pools in Singapore have a certain level of chlorine as a disinfection. But Talking Point speaks with Prof Shane finds out about the consequences of chloromine in our swimming waters.

Click here to watch the episode
Or read the article

Link to the full ST article here

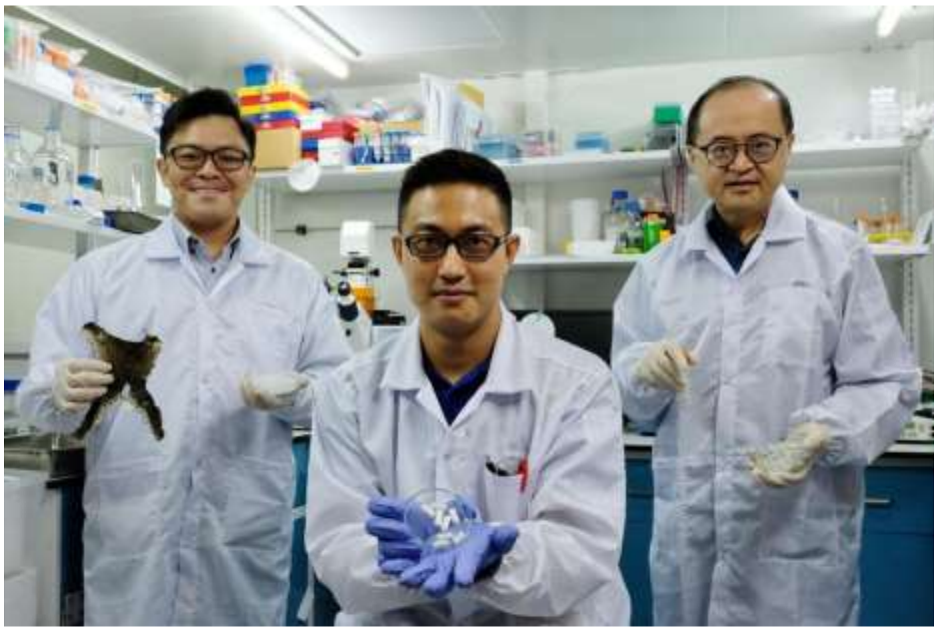
NTU scientists use aquaculture waste for tissue repair

Scientists at Nanyang Technological University (NTU) have developed a new biomaterial, made entirely from discarded bullfrog skin and fish scales, that could help in bone repair. The porous biomaterial, which contains the same compounds that are predominant in bones, acts as a scaffold for bone-forming cells to adhere to and multiply, leading to the formation of new bone.

To make the biomaterial, the team first extracted Type 1 tropocollagen (many molecules of which form collagen fibres) from the discarded skins of the American bullfrog, locally farmed and imported into Singapore in large numbers for consumption; and hydroxyapatite (a calcium-phosphate compound) from the scales of snakehead fish, commonly known as the Toman fish.
The NTU Singapore team found that human boneforming cells seeded onto the biomaterial scaffold successfully attached themselves and started multiplying – a sign of growth. They also found that the risk of the biomaterial triggering an inflammatory response is low. Such a scaffold could be used to help with the regeneration of bone tissue lost to disease or injury, such as jaw defects from trauma or cancer surgery. It could also assist bone growth around surgical implants such as dental implants.

The scientists believe the biomaterial is a promising alternative to the current standard practice of using a patient's own tissues, which requires additional surgery for bone extraction. At the same time, the production of this biomaterial tackles the problem of aquaculture waste, said assistant professor Dalton Tay of the NTU School of Materials Science and Engineering (MSE), who led the multidisciplinary study.

Collagen extraction from bullfrog skin, combined with HA (hydroxyapatite) from fish scales form the biomaterial a structure, composition that promote cell attachment
PHOTO: NTU SINGAPORE



(From left) NTU Assistant Professor Dalton Tay, NTU research fellow Dr Wang Jun Kit, and NTU Prof Matthew Hu Xiao are part of the research team that developed the new biomaterial.
PHOTO: NTU SINGAPORE (May 2021)

Professor Matthew Hu Xiao, co-author of the study and director of the Environmental Chemistry and Materials Centre at NEWRI, said that aquaculture waste can also be converted into green chemicals and materials environmental remediation and timely treatment can reduce wastewater contamination.

Prof Tay said: "*We took the 'waste-to-resource' approach in our study and turned discards into a high-value material with biomedical applications, closing the waste loop in the process. Our lab studies showed that the biomaterial we have engineered could be a promising option that helps with bone repair. The potential for this biomaterial is very broad, ranging from repairing bone defects due to injury or ageing, to dental applications for aesthetics.*

Our research builds on NTU's body of work in the area of sustainability and is in line with Singapore's circular economy approach towards a zero-waste nation."

The research team has filed patents for the biomaterial's wound healing & bone tissue engineering applications and is now further evaluating the long-term safety and efficacy of the biomaterial as dental products and aims to bring the waste-to-resource technological pipeline closer to commercialization.

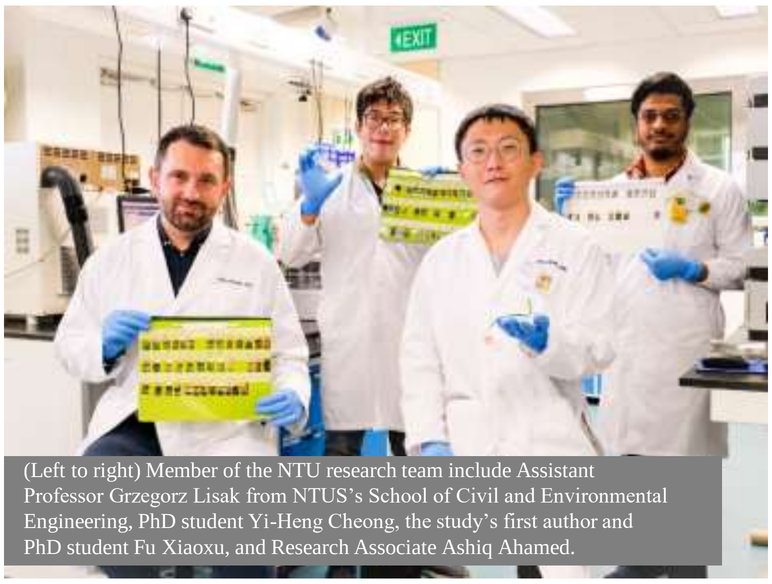
The research team hopes to work with clinical and industrial partners on animal studies to find out how tissues in the body would respond to this biomaterial in the long term, and the material's ability to repair bone defects and dermal wounds, as well as to bring the entire waste-to-resource technological pipeline closer to commercialisation.

Article appeared in ST
May 2021

For all the media coverage, click here
For CNA's media coverage, click here

Link to the full ST article here

NTU TEAM DEVELOPS 3D MAPPING DEVICE TO IMPROVE DIAGNOSIS AND TREATMENT OF SKIN CONDITIONS



(Left to right) Member of the NTU research team include Assistant Professor Grzegorz Lisak from NTUS's School of Civil and Environmental Engineering, PhD student Yi-Heng Cheong, the study's first author and PhD student Fu Xiaoxu, and Research Associate Ashiq Ahamed.

A team from Nanyang Technological University, Singapore (NTU Singapore) has developed a portable device that produces high-resolution 3D images of human skin within 10 minutes.

The device presses a specially devised film onto the subject's skin to obtain an imprint of up to 5 by 5 centimetres, which is then subjected to an electric charge, generating a 3D image. The device maps out the depth of the ridges and grooves of the skin at up to 2mm, it could also help with monitoring wound healing. The portable skin mapping (imaging) device could be used to assess the severity of skin conditions, such as eczema and psoriasis.

The researchers designed and 3D printed a prototype of their device using polylactic acid (PLA), a biodegradable bioplastic. The battery-operated device which measures 7cm by 10cm weighs only 100 grams, was developed at a fraction of the cost of devices with comparable technologies, such as optical coherence tomography (OCT) machines, which may cost thousands of dollars and weigh up to 30kg.

Assistant Professor Grzegorz Lisak from NTU's School of Civil and Environmental Engineering, who led the research, said: "Our non-invasive, simple and inexpensive device could be used to complement current methods of diagnosing and treating skin diseases. In rural areas that do not have ready access to healthcare, non-medically trained personnel can make skin maps using the device and send them to physicians for assessment."

Providing an independent comment on how the device may be useful to clinicians, Dr Yew Yik Weng, a Consultant Dermatologist at the National Skin Centre and an Assistant Professor at NTU's Lee Kong Chian School of Medicine, said: "The technology is an interesting way to map the surface texture of human skin. It could be a useful method to map skin texture and wound healing in a 3D manner, which is especially important in research and clinical trials. As the device is battery-operated and portable, there is a lot of potential in its development into a tool for point of care assessment in clinical settings."

First author of the study, Mr Fu Xiaoxu, a PhD student from NTU's School of Civil and Environmental Engineering, said: "The 3D skin mapping device is simple to operate. On top of that, a 1.5V dry battery is all that is necessary to run the device. It is an example of a basic, yet very effective application of electrochemistry, as no expensive electronic hardware is required."

Published in the scientific journal Analytica Chimica Acta this month, the technology was developed by Asst Prof Lisak, who is also Director of Residues & Resource Reclamation Centre at the Nanyang Environment and Water Research Institute (NEWRI) and his PhD student, Mr Fu Xiaoxu.

Mr Fu Xiaoxu, a PhD student from NTU's School of Civil and Environmental Engineering holding the prototype

The key component of the NTU device is a polymer called PEDOT:PSS, commonly used in solar panels to convert light into electricity. However, the team found a different use for its electrical conductivity - to reproduce skin patterns on gold-coated film. Asst Prof Lisak added: "The device has also proven to be effective in lifting fingerprints and gives a high-resolution 3D image of their characteristics."

To further validate its efficacy, the team is exploring conducting clinical trials later this year to test the feasibility of their device, as well as other potential therapeutic uses.

Article appeared in ST
February 2021

For all the media coverage, click here

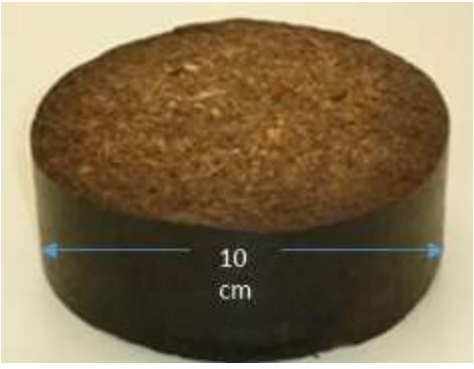
For the press release, please click here.

JFE TO DEMONSTRATE BIOCOKE UTILIZATION AT SHAFT-TYPE GASIFYING AND DIRECT MELTING FURNACE IN SINGAPORE

JFE Engineering Corporation is conducting a demonstration project utilizing Biocoke as a fuel in its 'Shaft-type Gasifying and Direct Melting Furnace' *1 in early May 2021 in collaboration with Nanyang Technological University, Singapore (NTU) and Kinki University (Kindai) in Japan.

Singapore generates significant amounts of waste biomass such as wood waste, sawdust, and biomass from sewage sludge. The research project aims to harness these resources in the form of Biocoke as part of the ongoing global effort to develop technologies for the utilization of waste biomass.

Biocoke is an innovative bio-recycled fuel which can be made from a variety of biomass resources and contributes to reducing CO_2 emissions. This research project is supported by the National Research Foundation, Prime Minister's Office, Singapore, and the National Environment Agency, Ministry of Sustainability and the Environment, Singapore under its Waste-to-Energy Test-bedding and Demonstration Funding Initiative*2.



Biocoke

"Producing biocoke from locally available waste biomass sources is more sustainable and an even greener alternative to imported charcoal." says Assistant Professor Grzegorz Lisak from the School of Civil and Environmental Engineering – NTU.

"We hope to show that the biocoke technology is a feasible option and that it can be successfully implemented to bring Singapore one step closer towards a zero-waste nation."

During the course of this research, JFE will test the suitability of Biocoke as a partial replacement for the auxiliary fuel required to achieve melting of waste. The test will be carried out using the JFE Shaft-Type Gasifying and Direct Melting Furnace*3 at the NTU-NEA WtE Research Facility in Tuas, Singapore.

With the execution of this R&D project, JFE reaffirms its continuous commitment to support the development of sustainable societies worldwide through the application of advanced technologies such as the upcycling of unutilized waste biomass resources.

FE Shaft-Type Gasifying and Direct Melting Furnace
(NTU-NEA WtE Research Facility)

For inquiries regarding this press release, please contact:
•Public Relations Section, General Administration Department, JFE Engineering Corporation

*1 The Shaft-Type Gasifying and Direct Melting process is JFE's most advanced waste treatment technology and enables gasification of waste and melting of its inert fraction in a single furnace. The incombustible fraction of waste is converted into slag and metal, which can be separated and safely reused and recycled. The flexibility and robustness of this system allow for the treatment of diverse waste streams ranging from Municipal Solid Waste (MSW) to excavated landfill waste and even Incineration Bottom Ash (IBA). This system can, therefore, contribute to alleviating the pressure on final disposal sites with limited capacities.

*2 Grant award reference number.: WTETD-2019-1R-10

*3 Constructed by JFE in March 2019.

FLOW-ELECTRODE CAPACITIVE DEIONIZATION SYSTEMS FOR THE SELECTIVE RECOVERY OF RESOURCES FROM WASTEWATER

An electrochemical approach to achieve simultaneous desalination and fractionation of wastewater based on the permselectivity and the size exclusion effect of ion-exchange membranes (IEMs).

Contributed by: Dr Tang Kexin, Dr Zheng Han (EPMC)

The direct discharge of wastewater into the environment is the leading cause of soil and aquatic pollution, which poses a global risk to human health. Many wastewater treatment technologies have been developed to remove harmful substances and recover resources from wastewater. The complex composition of wastewater bodies (*e.g.*, salts, heavy metals, nutrients, and organic matters) corresponds to multiple steps of treatment processes.

The greatest concern pertaining to wastewater treatment technologies is the integration of membrane-based separation processes. Since integrated membrane-based processes are prone to scaling and fouling, frequent regeneration and replacement of membranes are required, which results in secondary pollution and increased processing costs.

Another critical issue of the integrated membrane-based treatment lies in the difficulty of selectively removing and recovering specific components. In contrast, the electrochemical treatment directly utilizes electrical energy to separate, precipitate, and degrade target components in wastewater, which has been demonstrated as an efficient and environment-friendly approach. Moreover, electrochemical modules can be easily implemented in series or in parallel to realize a one-step treatment of wastewater and reduce equipment costs. Presently, the technical challenges of recovering resources from wastewater include increasing the wastewater treatment capacity of existing techniques, the selective recovery of target components, the reduction of energy consumption, and avoiding the generation of secondary pollutants.

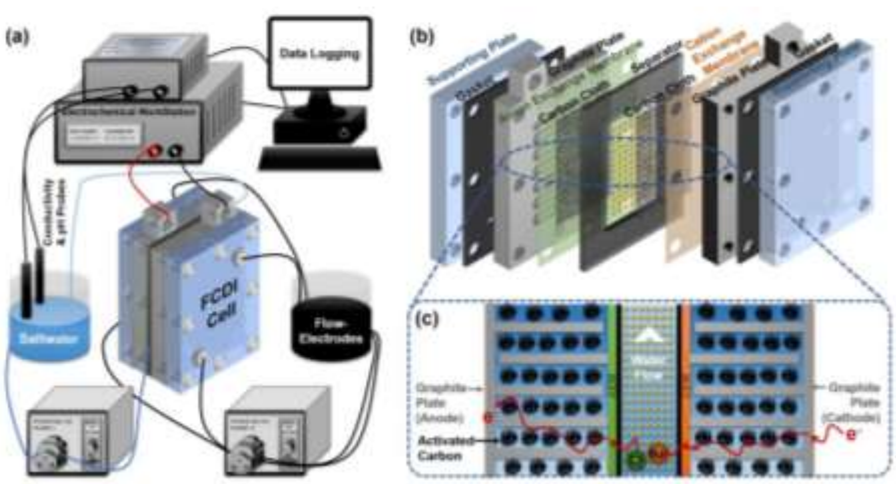


Figure 1. Schematic diagrams: (a) FCDI process, (b) assembly of the FCDI module, and (c) details between the anode and cathode flow compartments of the FCDI module.

Flow-electrode capacitive deionization (FCDI), an electrochemical approach with the its schematic diagram shown in Figure 1, can achieve the simultaneous desalination and fractionation of wastewater based on the permselectivity and the size exclusion effect of ion-exchange membranes (IEMs).

In our previous study, the research team from Environmental Process Modelling Centre (EPMC) has analyzed the voltage–current (V–I) characteristics of several FCDI modules and concluded that a continuous, rapid, and stable desalination performance of FCDI in the overlimiting current regimes can be attained when the employed FCDI module possesses a linear V–I characteristic, which is distinct from the three V–I regimes in electrodialysis and the two in membrane capacitive deionization (Figure 2). Notably, the linear V–I characteristic of FCDI requires continuous charge percolation near the boundaries of ion-exchange membranes. Effective methods include increasing the carbon content of the flow-electrodes and introducing electrical or ionic conductive intermediates in the solution compartment.

To go beyond the excellent desalination performance achieved, the research team aims to develop different types of modified FCDI modules for the selective recovery of resources from various wastewater bodies together with desalination, fractionation, and degradation functions at a high treatment capacity and low energy consumption.

The modified FCDI modules are constructed by introducing various functional layers on the surfaces of the IEMs. Experimental and modelling approaches will be employed initially to understand the fundamental mechanisms of selective resource recovery in the FCDI systems. We will then fabricate the selective layers with specific functions (e.g., electrosorption, precipitation, and degradation) using methods including direct attaching, chemical synthesis, and 3D printing.
We will finally verify the effectiveness of the developed FCDI modules through treating various real wastewater bodies.

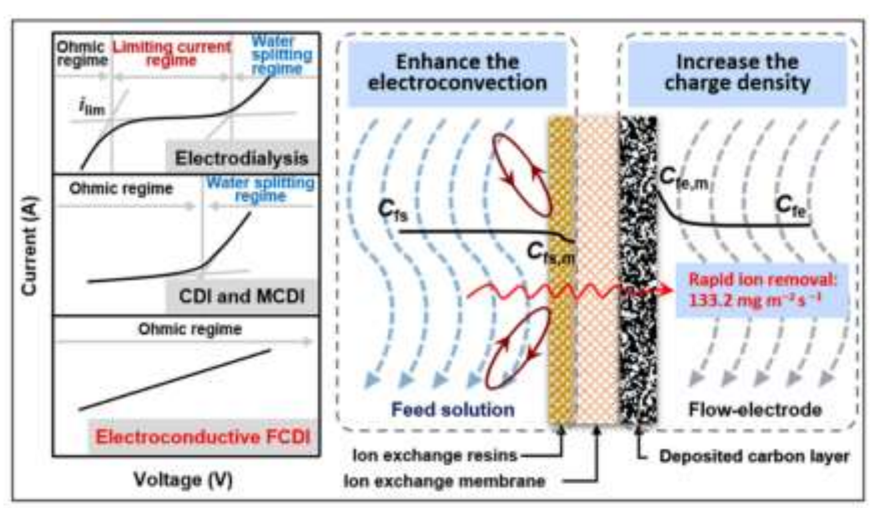


Figure 2. Schematic diagrams of the V–I characteristics in the electrodialysis, CDI, MCDI, and FCDI modules and the enhanced ion transfer across the IEM when there is electroconvection on the IEM surfaces.

Further reading / References:

1. Tang, K.; Hong, T. Z. X.; You, L.; Zhou, K., Carbon–metal compound composite electrodes for capacitive deionization: synthesis, development and applications. J Mater Chem A 2019, 7, (47), 26693–26743.

2. Tang, K.; Zhou, K., Water Desalination by flow-electrode capacitive deionization in overlimiting current regimes. Environ Sci Technol 2020, 54, (9), 5853–5863.

Analytic Cluster

INTRODUCING 2 OF NEWRI'S LATEST EQUIPMENT

Bringing the latest technologies to expand the capabilities of NEWRI's research is one of the key focuses of the Analytics Cluster. In this issue, we bring to you 2 of our most recently acquired equipment which enable quantification of aqueous dissolved compounds through spectrometry.

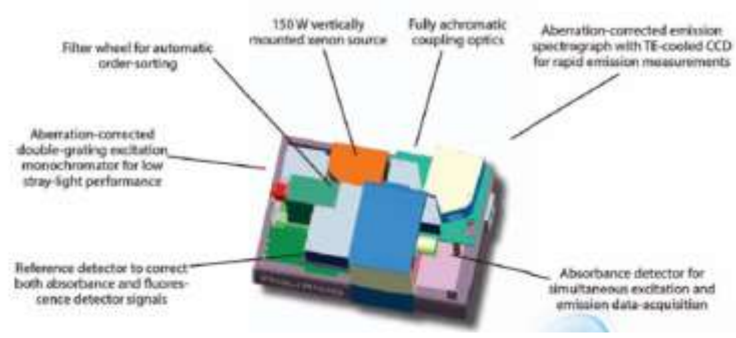
Contributed by:
Ms Janelle Ng
Ms Koh Danyu
(Analytic Cluster)

Horiba aqualog®-uv-800-c with sipper

The HORIBA Aqualog® A-TEEM spectrometer is a powerful tool to identify and quantify both high and low concentrations of dissolved compounds in environmental biology and water analysis.

It is the only instrument in the world that is able to simultaneously measure both the absorbance spectra and 3D fluorescence Excitation-Emission Matrices (EEMs) with extreme accuracy. Its data processing software boasts of time-saving one-click functions used to eliminate Inner Filter Effects (IFE), Rayleigh masking, and conduct normalization.

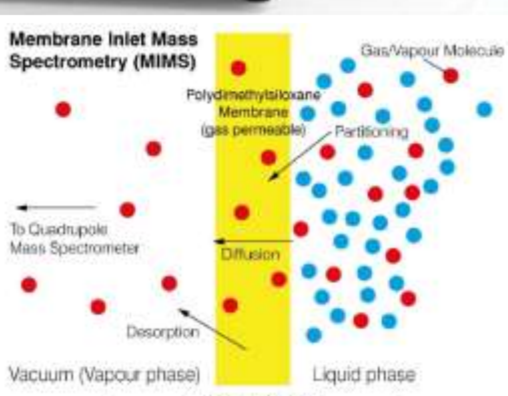
The WS-10 Sipper also enables automatic extraction of up to 4 samples from 4 different tubes.



Membrane inlet mass spectrometer (MIMS)

Membrane Inlet Mass Spectrometry is a technique used for resolving dissolved gas species from liquid samples using a semi-permeable membrane to isolate the mass spectrometer from the aqueous media and preferentially transmit the dissolved gases and organic vapors for analysis.

Hiden Analytical HPR-40 DSA MIMS is versatile, robust and portable for use in laboratory and field-based applications. This bench-top system allows for in-situ mass determination of dissolved species with real time quantitative analysis and monitoring at sub-parts per billion (ppb) level.



MORE of the myriad high-end equipment located in NEWRI. **CLICK THE BROCHURE**

DISCOVER

Philanthropy

NEWRICOMM UPDATE

Contributed by:
Josephine Chow

Earlier this year, saw NEWRIComm successfully completed implementing an exemplary project of engaging local SMEs in a regional project.

NEWRI was proud to collaborate with Century Water Singapore to co-design a suitable treatment process with Century Water's NF membrane that saw a nanofiltration membrane water treatment system implemented in Mandalay, Myanmar for hard water. Century Water Systems & Technologies Pte. Ltd designed and developed a novel NF hollow fiber membrane different from commercially available NF membranes that are made from interfacial polymerization, to remove hardness from source water providing healthy water for drinking.

Spurred by this success, NEWRIComm continues to engage with other SMEs such as Ovivo Singapore for another project in Chiang Rai, Thailand.

Prof Shane receiving a token from the principal of the school the handover ceremony at the Shree Saraswati Madhyamik Vidhyalaya in Nawalparasi, Nepal

The previous year (2020) was indeed a challenging year for the NEWRI Community as the impact of the Covid19 virus greatly affected accessibility to project sites, in addition to creating economic instability to our underserved beneficiaries in the respective developing cities.

Many of these communities continue to survive from hand to mouth, now face more difficulties with many having lost their income streams. Despite these difficulties, NEWRIComm has persisted to assist our LEF fellows to continue their progress in providing clean water access and sanitation to these communities through online training and remote project management.

A local school in Nawalparasi, Nepal. 2nd site for the implementation of arsenic water treatment

Further to our handover event in Nepal back in February 2020, NEWRIComm has continued to expand its implementation of arsenic water treatment in another local school in Nawalparasi, Nepal. The iron nails treatment system will be the second demonstration plant for local communities to learn and replicate in this arsenic contaminated region.

Besides designing our own solutions, NEWRIComm also believes in embracing newer treatment technologies to cost efficiently treat the targeted water challenges. We continue to make significant progress in Myanmar, Nepal and Thailand, implementing proven modern and conventional water treatment solutions.

Discover something new

Our series highlights a few (from the numerous) NEWRI publications because we do not forget our foundation of deep scientific research. NEWRI's researchers and professors from our various Centres of Excellence publish frequently in journals, conferences and keynotes.

Ba–Al-decorated iron ore as bifunctional oxygen carrier and HCl sorbent for chemical looping combustion of syngas

Liu, G., Wang, H., Deplazes, S., Veksha, A., Wirz-Töndury, C., Giannis, A., Lim, T.T., Lisak, G.

Abstract

The simultaneous high-temperature HCl removal and chemical looping combustion (CLC) of syngas over barium-decorated oxygen carriers (OCs) was investigated. An iron ore was coated with a layer of sorbent (5 wt%) containing Ba and Al compounds (molar ratios Al:Ba = 0.5, 2.0, 4.5, 8.0, 12) and used for model syngas combustion at 800 °C. It was found that the synthesized materials can effectively remove HCl from the syngas. The HCl removal capacity increased with the Ba loading, and the HCl breakthrough capacity can reach 0.0345 mmol/g for the OC with Al:Ba = 0.5, resulting in the formation of $BaCl_2$.

The conversion of Ba species into $BaCl_2$ was 17.3%. Besides the HCl sorption, the coating with Ba and Al compounds enhanced the activity of lattice oxygen and improved the reducibility of OCs during CLC due to the Ba–Fe composite formed on the OCs surface. Compared to the iron ore, the combustion efficiencies of the coated OC with Al:Ba = 4.5 for CO and H_2 increased from 62.2% and 87.2% to 99.6% and 95.9%, respectively. Through fluidized bed experiments and thermodynamic calculations, the feasibility of sorbent regeneration was demonstrated by treating OCs with a mixture of CO_2 and H_2O at 800–1000 °C.

The HCl desorption rate increased with temperature and nearly complete sorbent regeneration (99.6%) could be achieved at 1000 °C. These findings demonstrate that Ba–Al-decorated iron ore can be used as bifunctional material in CLC process since it enables simultaneous high-temperature HCl removal and syngas combustion.

Keywords

MSW syngas | HCl sorbent | Chemical looping combustion | Oxygen carrier | Barium

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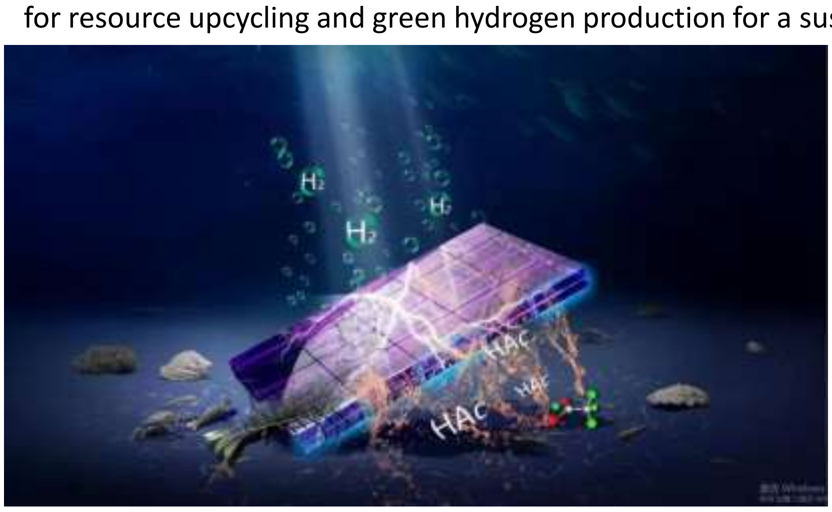
Raw biomass electroreforming coupled to green hydrogen generation

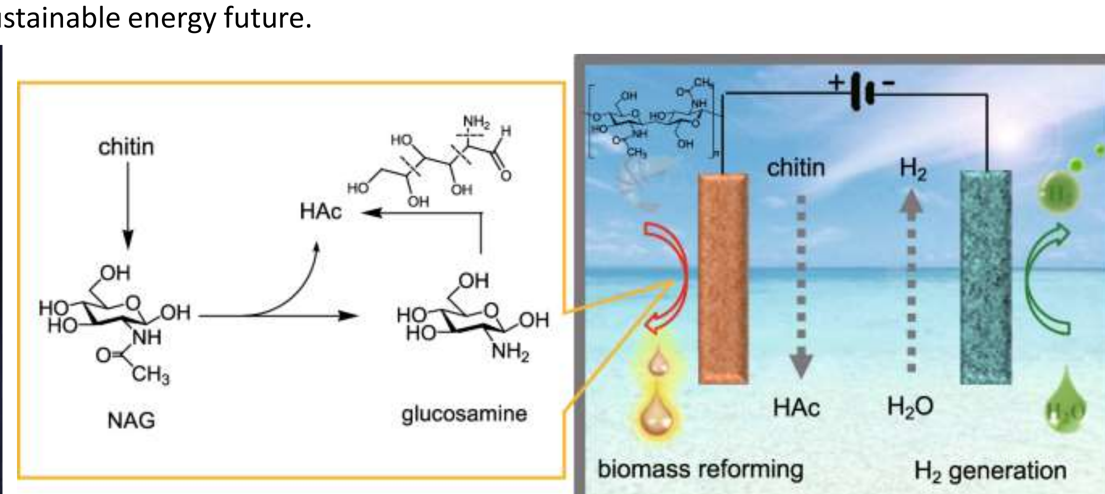
Hu Zhao, Dan Lu, Jiarui Wang, Wenguang Tu, Dan Wu, See Wee Koh, Pingqi Gao, Zhichuan J. Xu, Sili Deng, Yan Zhou, Bo You & Hong Li

Abstract

Despite the tremendous progress of coupling organic electrooxidation with hydrogen generation in a hybrid electrolysis, electroreforming of raw biomass coupled to green hydrogen generation has not been reported yet due to the rigid polymeric structures of raw biomass.

Herein, we electrooxidize the most abundant natural amino biopolymer chitin to acetate with over 90% yield in hybrid electrolysis. The overall energy consumption of electrolysis can be reduced by 15% due to the thermodynamically and kinetically more favorable chitin oxidation over water oxidation. In obvious contrast to small organics as the anodic reactant, the abundance of chitin endows the new oxidation reaction excellent scalability. A solar-driven electroreforming of chitin and chitin-containing shrimp shell waste is coupled to safe green hydrogen production thanks to the liquid anodic product and suppression of oxygen evolution. Our work thus demonstrates a scalable and safe process for resource upcycling and green hydrogen production for a sustainable energy future.





Keywords

Chemical engineering | Electrocatalysis | Sustainability

https://www.nature.com/articles/s41467-021-22250-9

AWARDS

Lim Yu Jie awarded 3rd prize for Poster

Published on: 13-Jan-2021

Lim Yu Jie was awarded the 3rd prize for poster competition (out of 352 posters) in the 12th International Congress on Membranes and Membrane Processes (ICOM 2020 conference). ICOM is the largest and most important conference on membrane science and technology, bringing together leading membranologists and researchers to share the latest developments in this field with particular focus on emerging trends in science as well as industrial use of membranes.

ICOM conferences are organized every three years, alternating between the continents of Asia, North America and Europe. ICOM is supported by the three biggest membrane societies: the Aseanian Membrane Society (AMS), North American Membrane Society (NAMS) and European Membrane Society (EMS). Recently in 2017, ICOM was formalised by the World Association of Membrane Societies (WA-MS).

Dr Chuah Chong Yang receives Green Talent Award 2020

Published on: 12-Jan-2021

Dr Chong Yang Chuah, who is currently a Research Fellow in Singapore Membrane Technology Centre (SMTC) was recently honoured with a Green Talent Award in the Green Talent Competition 2020. This award recognizes Dr Chuah's accomplishment in new and innovative method of capturing greenhouse gases together with the efforts in investigating the gas separation performance under practical operating conditions.

This competition is organized by the German Federal Ministry of Education and Research (BMBF) annually to promote international exchange of innovative green ideas from various fields of research. The competition focuses on outstanding young research scientist who are active in the field of sustainable development. This year, 589 applicants from 87 countries had participated in this competition.

LONG SERVICE RECOGNITIONS

NEWRI staff achieving their Long Service awards to NTU.

Ms Ohmar
Assistant Manager
NEWRI

Dr Santosh Pathak
Research Fellow
NEWRI

Mr Zhang Lizhi
Research Associate
NEWRI-SMTC

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