



BIANNUAL NEWSLETTER

A MESSAGE FROM :: the editor

Dear ISMET Community,

Firstly, apologies for this somewhat late version of ISMET news. 2021 was a tough year, in some ways more difficult than the one before. The 'new normal' that we were all told to settle into seems to be that there is no normal. The situation has been highly changeable, I have felt like I have entered every working week not knowing if: my kids would be at home or at school; students would be in lecture rooms or on zoom; I would be advised to be in my work office or at home; and (possibly most crucially) whether I would be able to go for a beer at the end of the week or not.

Despite the lack of normality and the stresses and strains of life, our amazing community has produced fantastic conferences highlighting the high quality research ongoing around the globe. The round up of these conferences are written about in this issue, many thanks to the contributors Sanne, Anaïsa and Frauke. We also celebrated the transfer of President to Falk Harnisch, in this issue Annemiek reflects on her time as President, in our next issue we will hear from Falk. I am particularly pleased to share with you the outreach section, this issue highlighting the work on Musical Fuel Cells, combining art and science – inspirational. I know many other members are also conducting fantastic outreach work, so please do get in touch if you would like to feature in the next newsletter.

So maybe 2021 was not that bad, there were many good parts too. A personal highlight for me was getting fit and taking part in my first Great North Run half marathon here in Newcastle, I managed a run time of 2 hours 11 minutes, and more importantly raised over £2000 for Children's Cancer North, in memory of my beautiful niece who died 10 years ago aged 6. I leave you with a sketch inspired by this, about how I felt to reach the end of last year, and a photo of me, still smiling at the end of the race.

Dr. Liz Heidrich
ISMET news Editor



Dr. Elizabeth Heidrich



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A MESSAGE FROM :: the president

Dr. Annemiek ter Heijne



It's been a special two years to be president of ISMET. After taking over the lead from Sarah at ISMET7 in Okinawa, Japan, who would have thought that we were not going to have any live meetings for the (at least...) two following years?

From the positive side: I'll enter the ISMET history books as the president with the lowest CO₂ emissions ever! And despite this sudden and unexpected change to online meetings only, I am amazed that we have managed to stay in contact, to have board meetings to keep ISMET alive and kicking, to enjoy online chatting at the virtual ISMET meetings, to further extend the ISMET network to South-America and Africa, and to organize the WISMET (Women in ISMET) seminars - just to mention a few highlights. In Okinawa, I announced my plan to develop an online MSc and PhD course on Microbial Electrochemical Technologies, which I hope to shape further now that I'm "retired" from ISMET - will keep the community posted!



The power of ISMET lies in all the enthusiastic and committed PhDs, postdocs, senior researchers and other members. Our excitement of the interdisciplinary field of Microbial Electrochemical Technologies keeps us together and it was so great to hear that even the PhDs who joined the community online only felt welcome & connected. And it is clear that I could not completely let go of ISMET and therefore proposed to organize the EU ISMET meeting that will be held in 2023 in Wageningen. Let's keep up the good research spirit, engage in the field and in ISMET, and I look forward to meeting many of you at one of the future conferences!

Dr. Annemiek ter Heijne
ISMET President pro tem

Girona shining from our screens



Girona, Spain

The 5th EU-ISMET was a big success! What stood out most was the community feeling that got across even though we were all in our hometowns. With over 200 people online during the conference and also quite some post-attendees rewatching the presentations we never felt like we were attending alone, even from our own office or home. The first thing that appeared when entering the platform was the photo booth which already put faces to all those anonymous question-typing attendees. The online platform was well structured, which allowed us easy navigation through all the presentations, sessions, attendees and posters. When we think back on how the pandemic started and forced us to move to online meetings and conferences, it's great to see that we have all adapted so well to this new structure and found our ways with the new ways of connection.

Besides being virtual, the Organizing Committee of the 5th EU-ISMET Conference organized the pre-congress workshop, which gave us the opportunity

to learn more about fundamental knowledge and technical aspects of the field from renowned leaders in the field, namely Dr. Bernardino Viridis, Dr. Benjamin Korth and Dr. Sara Tejedor-Sanz.

We also had the opportunity to visit Girona through a guided tour. Maybe because we had not been together for too long and could not travel due to the pandemic period, this was a fantastic experience even though we were all sitting comfortably thousands of miles away watching through our screens. Also Game of Thrones fans could imagine themselves on the set of the series. With the colourful houses and the majestic buildings you cperiod, this was a fantastic experience even though we ould almost smell the river. Hopefully in the future we can make the virtual tour a reality!

The platform functionalities allowed us to find like-minded people in the field by automatically making a match. This would not have happened in an in-person conference, due to the busy schedule of the conference days and due to the high number of participants that so well characterizes our ISMET community. Also the chat facilities allowed the conversations between speakers and audience to continue after each presentation. Interesting conversations were being held, ranging all the way from scientific discussions to ideas of joining some hiking or running trails together. The ISMET community is lively, young, vibrant and welcoming.

The various sessions also showed the diversity of the ISMET community. The topics were very widespread, from fundamental electron transfer mechanisms, electro-active

Girona shining from our screens

microorganisms, materials to applications of bioelectrochemical systems and even commercialization of the techniques. This allows us as scientists, process engineers, and teachers to not only dive deeper into our own favorite topics, but also to other sides of microbial electrosynthesis and paint the bigger picture.

There was also the possibility of revisiting the presentations longer throughout the year. We have noticed that even now, some weeks after the end of the conference, there are always a few attendees still online. This shows both how interesting the multiple presentations were as well as how curious the audience is.

The closing session with the president of ISMET was memorable, as we were practically at a gala dinner watching the announcements and the awards ceremony. Besides that, we were also invited to a final toast. It was fantastic.

Finally, we would like to gratefully thank the organizers for putting all their efforts, creativity and inspiration in this conference.

Was EU-ISMET really an online conference?

That is the question that remains after the meeting is over.



Anaísa Coelho, PhD student at ITQB NOVA, Portugal.
Working on Fundamental aspects of Extracellular Electron
Trans+fer on the metabolism of *Sideroxydans lithotrophicus ES-1*



Sanne de Smit, PhD student at Wageningen University
and Research, Netherlands.
Working on bioelectrochemical CO₂ reduction

call for nominations!



call for nominations :: ISMET FELLOWS

Our society has finally launched a call for ISMET fellows. This is the highest grade of membership that means Fellows have made outstanding contributions to the research field and the ISMET Society. Candidates can be nominated by all ISMET members (excluding self-nomination). Nominations must be submitted by the end of February 2022.

The first up to eight Fellows in 2022 are chosen by the board of directors based on the nominations from the ISMET community. Thereby the board aims for gender equality as well as regional equality. Nominations are due by the end of February 2022.

A maximum of four new colleagues will be elected and announced every two years in synchrony with the global meetings of ISMET. The exact procedure will be defined after the appointment of the initial up to eight Fellows.



An ISMET Fellow is an honorary appointment that is certified by receiving a plaque. In return the Fellow continues in providing service to our society. The title can be withdrawn for reasons of misconduct by a combined decision of the ISMET Fellows and the current Board of Directors.

ISMET Trojans at USC



Dr Frauke Kracke – Staff Scientist at Stanford University and long-term ISMET member!

Did this really just happen? After months of isolation due to the global pandemic, about 70 ISMET members: students, professors, scientists, engineers, and electromicrobiology enthusiasts followed Moh's call to USC to spend three days together in LA. It seems that only the Californian sun didn't get the memo to show up.

It was the first in person meeting for many of us and we definitely made the most of it! Clearly, the ISMET community has not been sitting idle during global shutdowns. Did you know that *Shewanella* EET can power radical polymerization? Ever heard about swiss-cheese photocathodes for H₂ production? Or semiconductor quantum dots that facilitate photocatalytic N₂-fixation in microbes?

The meeting was launched by asking the big questions, like "what is life?" - Carbon and energy of course! The participants shared inspiring visions, for example how "biology could revolutionize our energy economy over the next 80 years!" We discussed future questions around sustainability, and climate, the role of hydrogen and how the promisingly high, theoretical peak conversion efficiencies of MES warrants research efforts in that area. We heard about application focused advancements such as hydrogen-driven MES powered by intermittent, renewable energy, and breakthroughs in MEC design (turns out "we were trying to balance the wrong iron"). All the way to the inspiring journey of ISMET scientists pushing MFC wastewater treatment technology through the 'start-up valley of death' and turn it into a successful sustainability venture!

Surely, talks around the fundamentals of (extra)cellular electron transport processes could not be missing. We talked

about cell secreted redox shuttles and news on the electron in and out in our favorite *Shewanella*, including introduced rhodopsin for photoexcitement! We marveled over cool pictures that enable the visualization of specific layers in biofilms composed of *Geobacter* mutants. Further, we got introduced to cool techniques like electrochemical NAD/NADH determination, and optics for single molecule imaging that are capable of visualizing single redox proteins. After the bionic leaf, microbial biotechnology introduced us to artificial root nodules for N₂-fixation. We learned about the role of iron-dependent EET in enterococcal pathogenesis, microbial electrochemical photosynthesis, how to use an anode to increase the rate and yield in lactic acid bacteria fermentation, and how to successfully catch your electroactive-bacteria-pokémon!

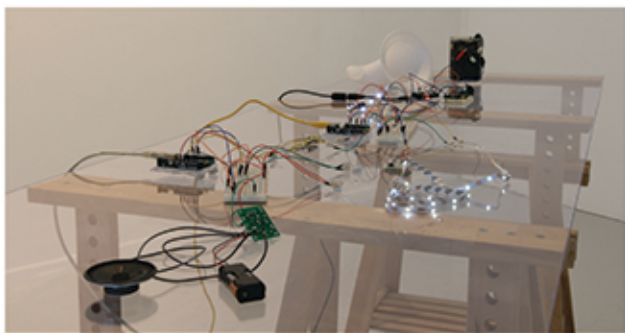
The conference organization team did a fantastic job to pull off this event during uncertain times and with all the additional safety regulations in place. Several participants that were not able to join us in person and could be accommodated by virtual presentations for the audience at USC. We had such a great time enjoying breakfast together on campus and lunches under palm trees. The final, surprise dinner under illuminated fig trees including margaritas was a perfect setting for a special night together after such long time apart! We want to congratulate Grace Chong and Biki Kundu for winning awards for best oral and poster presentations, as well as thank the organization team one more time – Moh El-Naggar, Christina Tasulis Williams, Bingran Cheng, and everyone else involved, thank you for making this meeting happen!

We can't wait to repeat this with the global ISMET community in Greece in 2022!

Bioelectrochemistry to reach the general audience

Interacting with the public is a worthwhile endeavor, and we have seen it this way in this newsletter, narrating the practices of various ISMET members. We inaugurated a new section committed to outreach, which will depict the diverse experiences to make our research and its achievements available to the general audience.

During the last EU-ISMET meeting, the special round table EU-ISMET goes to high schools showed the results of the Challenge Cell, organised by host UdG-Lequia group (see ISMET News #19). The original proposal –training students from 15 high schools from Girona on microbial electrochemistry, was adapted to the pandemic requirements, with absolute success. For this purpose, they collaborated with the Institute of Education Sciences Josep Pallach and the UdG Water Campus. The rest of the speakers exchanged experiences and views on how to bring bioelectrochemistry to the general public from primary schools to art installations.



'Musical' Fuel Cells

Can we make music with microbial fuel cells? MFCs have been extensively proposed for engineering applications. However, the interaction between microorganisms and electrodes entails a huge potential for educational, and even for artistic purposes.

In Leitrim (Ireland), the current artist in residence Margaret O'Brien presented last November four artistic installations focusing on the translation of energy from one material to another, demonstrating the interconnection between things and the impact of the environment on the subject. Her installation Interference IV showed the

generation of electricity, sound, and even music from living soil sediment. "Relationships between art and science are core to my practice and the potential that MFCs present are immensely exciting. I am very grateful to Dr. Paolo Dessì and Carlos Sánchez for their expertise in developing this artwork with me", said Dr O'Brien.

The first phase involves an MFC using marine sediment from the West Coast of Ireland. The cell produces a live electrical voltage, specific to the sediment, site, and time of year, that is transformed into musical tones using a circuit board and a piezoelectric buzzer. In the second phase, the musical output of the MFC provides a sensory input that triggers a series of lights to come on and off in response to the variations in sound. Finally, the third phase transfers the activity of the lights back into sound of different tones to the first phase. Changes occur when the energy is transformed from one phase to the next so that, whilst the phases are interconnected, they are distinct from each other.

The sediment MFC and the circuit board have been designed, respectively, by Dr Paolo Dessi and PhD candidate Carlos Sánchez, researchers at the National University of Ireland Galway. "It was a pleasure to collaborate in this project, which offers an invaluable occasion to approach the general public showing concretely that we can generate electric current from the soil," said Dr Dessi.

Video available at

<https://drive.google.com/file/d/1eRnEzP6Wf2JmrVp2HAQ3DeAqrGMN6PAh/view>

Belén Barroeta

With contributions from Paolo Dessi, NUI Galway
Image / video credits: Margaret O'Brien

Modular METland®

a sustainable solution for electrobioremediating wastewater

Believe or not, the first METland® concept was already born more than a decade ago by integrating MET elements in a classical wastewater technology like treatment wetland. The result was a new design where microbial electrochemistry was not necessarily based on the use of independent anodes and cathodes, but on the use of anodic and cathodic reactions along the volume of an electroconductive bed where bacteria and plants coexist.

Half a dozen PhD dissertations together with scientific papers have explored and demonstrated how electron flow can be domesticated to enhance electrobioremediation of pollutants and nutrients. No matter where this technology is implemented, their microbial communities electrotalk in the same Esperanto: the electrochemistry, an old language that may be decoded by the Ohm, Volta and Faraday laws.

METlands hit the road

Original METland® was constructed in soil following conventional designs used in treatment wetlands. However, lately the start-up company METfilter has developed a variety where modularity is a must. Such is a mobile, decentralized wastewater treatment that operates plug-and-play, adapting to any client need while reducing the conventional footprint by ca. 30-fold. The solution has received a number of international recognitions, but we felt especially honored when it was awarded as Best 2021 technological innovation by the ISMET.



Modular METland® treating Wastewater (25m³/day , 200 pe)

A modular METland® can treat water generated by ca. 100-200 people on a camping site, hotel, or small communities. As the units have been designed to fit shipping containers, they can be 3D-grown into larger structures because all ship containers are robust, made-of-steel, and have identical dimensions. Due to this modular design, additional construction is as easy as stacking more elements. Thus, we can easily upscale the treatment capacity based on direct replication of the modular unit.



Modular METland® designed for biodegrading micropollutants in the sino-EU ELECTRA Project (www.electra.site)

MET4home, a solution for single housing

One of the most important social aspects of modular METland® is the possibility of converting any water consumer citizen in a responsible user bridging the gap between new technologies and the end user. Typically, all engineering designs for treating wastewater require a level of expertise that creates a breach among a standard citizen and the technology. Our MET4home concept is looking forward to making every user conscious about the nexus water-energy while allowing them to play an active role in treating their own domestic pollutants.

Dr Abraham Esteve-Núñez
Bioe Group's leader, Spain



MET4home for treating wastewater from a single house

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