

Final report

13th International Summer School on Advanced Studies of Polymer Electrolyte Fuel Cells

Graz University of Technology, 6-14 September 2021

The *Summer School on Advanced Studies of Polymer Electrolyte Fuel Cells* was organised for the thirteenth time in cooperation between **Graz University of Technology** and **Yokohama National University**.



Fig. 1: Announcement of the "International Summer School on Advanced Studies of Polymer Electrolyte Fuel Cells".

The goals of this event include deepening the expertise of the participants, international and cultural exchange between researchers, and the opportunity to make new contacts and deepen existing ones. For the first time, this event was held in hybrid form - i.e. both online and on-site at TU Graz.

Intensive course

The seven-day intensive course was opened by Dean Prof. Frank Uhlig and Prof. Viktor Hacker. Prof. Uhlig also announced the continuation of the long-standing cooperation between TU Graz and Yokohama National University during the opening.



Fig. 2: Opening of the Summer Academy on site at TU Graz by Dean Prof. F. Uhlig (left) and Prof. V. Hacker (right).

The seven days of lectures covered the basics and principles of fuel cells (Prof. Hacker, TUG and Prof. Mitsushima, YNU), electrochemical basics (Prof. Gollas, TUG), catalysis (Dr. Napporn, Univ. Poitiers), kinetics (Prof. Kokoh, Univ. Poitiers), mass transport (Prof. Araki, YNU), thermodynamics (Dr. Reimer, FZ Jülich), measurement technology (Prof. Kuroda, YNU, Prof. Habrioux, Univ. Poitiers and Dott. Reimer, FZ Jülich), metrology (Prof. Kuroda, YNU, Prof. Habrioux, Univ. Poitiers and Dott. Squadrito, CNR), lifetime (Dr. Bodner, TUG), modelling (Prof. Kutrašnik, Univ. Ljubljana), hydrogen technology & hydrogen production (Prof. Kuroda, YNU and Dr. Bock, TUG) and hydrogen applications (Prof. Ota, YNU).

In addition to the lectures, the 14 speakers from Japan, France, Italy, Germany, Slovenia and Austria gave the 69 participants from seven international universities an understanding of the different aspects of these future-oriented technologies in various interactive exercises.

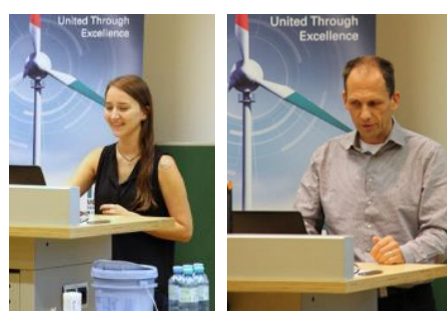


Fig. 3: Dr Bodner (left) and Prof. Kutrašnik (right) discuss future development potentials of PEFC.

Students were able to present and discuss their own research work online in a poster session. A total of 23 posters were presented in short talks. An international committee headed by Dr. Uwe Reimer (FZ Jülich) awarded four prizes to students from Japan, Slovenia and Austria for the outstanding presentation of their work.



Fig. 4: Online from Germany, Dr Reimer (left/o), from Japan Prof. Mitsushima (right/o) and Prof. Ota (left/u) and from Italy, Dott. Squadrito (right/u).

Finally, students who successfully pass the written examination have the opportunity to have the knowledge acquired at the Summer Academy credited to their studies as a free subject at Graz University of Technology or Yokohama National University. This means that successful participation also brings graduation a little closer.



Fig. 5: Dr. Bock (left) and Prof. Gollas (right) give an insight into the basics of hydrogen production and the fundamental principles of electrochemistry.

Interactive events

Several interactive courses were held as part of the event and to promote communication and cooperation between the participants. To this end, there was a quiz, the solution of which required students from different cultures to work together.

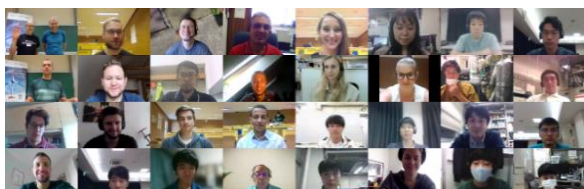


Fig. 6: Online group photo of participants of the International Summer School on PEFCs.

One gets an insight into this process through a recording of the shared whiteboard during the puzzle. After a short settling-in period, there was lively communication, which made it possible to cope well with the tasks.



Fig. 7: Section of a whiteboard while answering the questions for the intercultural quiz.

After the poster presentations, there was also a virtual poster session. Here, each presenter had their own virtual room in which it was possible to ask questions and hold discussions. Here, too, there were intensive discussions, some of which extended well beyond the allotted time window.



Fig. 8: Screenshot of the poster presentations

On the last day, the newly acquired knowledge was applied and deepened in practical examples in an interactive workshop.



Fig. 9: Demonstration of an electrolysis/fuel cell unit as part of the H2GreenTech project by Sigrid Wolf.

The correct results, the observable division of labour and cooperation of the participants and the intensive discussions showed the great interest and the increase in knowledge of the participants. The workshop ended with a practical demonstration of a laboratory fuel cell

unit (Fig. 9) of the H₂GreenTech project by Michaela Roschger and Sigrid Wolf.

Publication of the lectures

The lecture material is the book: From Fundamentals to Applied Research, Hacker, V. & Mitsushima, S. (eds.), 19 Jul 2018, Amsterdam, Elsevier. The abstracts of the 23 poster presentations were summarised in the abstract book. The contributions in the abstract book cover fuel cell and hydrogen research, starting from membrane fabrication, catalyst development, lifetime analyses, system developments, electrolysis to fuel cell developments for lunar missions.

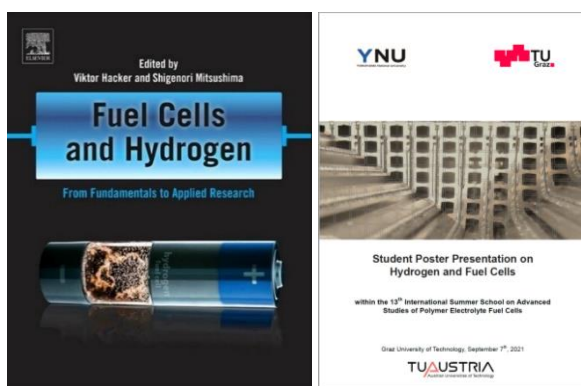


Fig. 10: Lecture notes Fuel Cells and Hydrogen, Elsevier (left) and the abstract book of the Summer School (right).

Further documentation on the Summer School can be found at www.tugraz.at/fcsummerschool. The next *Summer School on Advanced Studies of Polymer Electrolyte Fuel Cells* will be held at **Yokohama National University, end of August 2022**.

Acknowledgement

We would like to express our special thanks for the support of the Summer Academy by the lecturers and the helping hands on site, here especially to Brigitte Hammer and Sebastian Bock for the excellent organisation, Michael Lammer for the preparation of the abstract book and Mathias Heidinger for the technical support.

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