Kick-off meeting "JSPS Core-to-Core Program on Materials Intelligence" (hybrid onsite/online)

16 June 2022

Location: University of Twente, Ravelijn building, room 2503

Meeting URL: https://utwente-nl.zoom.us/j/81802113730?pwd=NG8rTWwxZGJlUjVFc0QrT2gwR3R2Zz09

Meeting ID: 818 0211 3730

Passcode: 757737

PROGRAM:

08.45 – 09.00   WALKIN WITH COFFEE

09.00 – 09.30   **Takuya Matsumoto (Osaka University)**
                 "Outline of JSPS Core-to-Core program for Materials Intelligence and Neuromorphic functions in molecular networks"

09.30 – 10.00   **Hirofumi Tanaka (Kyutech)**
                 "Future prospect of In-Materio Reservoir Computing Devices"

10.00 – 10.30   COFFEE BREAK

10.30 – 11.00   **Susan Stepney (University of York)**
                 "Magnetic Architectures for Reservoir Computing Hardware (MARCH)"

11.00 – 11.30   **Bart Jan Ravoo (Münster):**
                 Introduction to the collaborative research center "Intelligent Matter" at the University of Münster

11.30 – 12.00   **Konrad Szaciłowski (Krakow)**
                 "Light-induced synaptic plasticity in perovskite/polyheptazine heterostructures"

12.00 – 12.30   **Albert Wong (Twente)**
                 "Ration design of computable networks of reactions"

12.45 – 14.00   Lunch (Gallery, please sign up at brains@utwente.nl)

Attendants from Japan:
Prof. Takuya Matsumoto
Mr. Tomoki Misaka,
Mr. Masaya Matsuo,
Mr. Masahiro Nakayama

Prof. Hirofumi Tanaka
Dr. Yuki Usami
Mr. Rikuto Oyabu
Mr. Koki Kimizuka
Ms. Oradee Srikimkaew

Takuya Matsumoto (Osaka University)
"Outline of JSPS Core-to-Core program for Materials Intelligence and Neuromorphic functions in molecular networks".

Abstract
The minimal model of material neural information device is networked nodes with nonlinear electronic properties with steep threshold and hysteresis. We demonstrated that Coulomb blockade networks of protein/DNA indicated stochastic resonance, conducting polymer networks exhibited the reservoir computing for audio recognition, and resonance tunneling via Ru-complex with Au-nanoparticle bridge array showed various wave generation. These results suggest that molecular networks are potentially useful for brain-type neural computing.

Takuya Matsumoto obtained his Ph.D. in physical chemistry with the electron paramagnetic resonance of supersonic oxygen beam from Osaka University in 1990. He became Research Associate (1990) and Associate Professor (1998) at Institute of Scientific and Industrial Research, Osaka University. He was appointed Professor of Chemistry, Graduate school of Science, Osaka University in 2012. His main field of research is the study of biological and organic molecules at surfaces using scanning probe microscopy. Recently his interests are focused on neuromorphic functions in molecular network systems.

Susan Stepney (University of York)
"Magnetic Architectures for Reservoir Computing Hardware (MARCH)"
Abstract: Many substrates can be used to make (small) in materio reservoirs.
Often, making the substrate larger does not give a more computationally capable reservoir.
I will talk about our EPSRC-funded MARCH research project,
based on nano-magnet arrays, seeking to "scale up" through multi-reservoir architectures
Susan Stepney is Professor of Computer Science at the University of York, UK.
Her research interests include Unconventional Computing,
including in materio reservoir computing.

Bart Jan Ravoo (Münster)
"Introduction to the collaborative research center "Intelligent Matter" at the University of Münster"

2021 – present Speaker of the CRC 1459 "Intelligent Matter", WWU Münster
2016 – present Co-Director of the Center of Soft Nanoscience (SoN), WWU Münster
2012 – 2014 Dean of the Department of Chemistry and Pharmacy, WWU Münster
2010 – present Professor (W3), Organic Chemistry Institute, WWU Münster
2007 – 2010 Professor (W2), Organic Chemistry Institute, WWU Münster
2002 – 2006 Assistant Professor, Laboratory for Supramolecular Chemistry and Technology, MESA+ Institute for Nanotechnology, University of Twente (NL)
1999 – 2002 Newman Scholarship, Department of Chemistry, University College Dublin (IE)
1999 Postdoctoral Fellowship, Department of Chemistry, University College Dublin (IE)
1994 – 1998 PhD in Chemistry, University of Groningen (NL)
1988 – 1994 MSc in Chemistry, University of Groningen (NL)
Scientific Awards, Honors, Appointments and Professional Recognition
2019 "Goldener Brendel" Teaching Award, WWU Münster.
2012 Visiting Scientist, Weizmann Institute of Science, Rehovot (IL)
2010 Call of the MESA+ Institute, University of Twente (NL), declined
2010 Visiting Scientist, Tsinghua University, Beijing (CN)
1999 – 2002 Newman Scholarship, University College Dublin (IE)

Konrad Szaciłowski (Krakow)
"Light-induced synaptic plasticity in perovskite/polyheptazine heterostructures"

Konrad Szaciłowski graduated from the Faculty of Chemistry, Jagiellonian University (Kraków, Poland) in 1995 (MSc) and 2000 (Ph.D.). After habilitation (2008) he has moved from Jagiellonian University to AGH University of Science and Technology. Now he is a group leader at the Academic Centre of Materials and Nanotechnology. His initial interest in photochemistry and spectroscopy of coordination compounds has gradually evolved towards molecular and nanoscale logic devices and finally towards unconventional computing. At the moment his main research interests encompass the design of inorganic materials for memristive applications, mimicking of neutral and synaptic processes in inanimate systems, reservoir computing and relations of musical harmony with other fields of science. He is an author of the book "Infochemistry: Information processing at nanoscale" (Wiley 2012) and numerous papers in fields of coordination chemistry, material science, spectroscopy, catalysis, and electrochemistry. In his free time he enjoys classical music, philately and single malts from Islay and Speyside.

Albert Wong (Twente)
"Ration design of computable networks of reactions"
Abstract: Novel frameworks for future energy-efficient computing strategies require interdisciplinary approaches from computer science, mathematics, physics, biology, sociology, and countless other disciplines: Chemistry is often overlooked. In this talk, I will discuss our recent progress in creating Chemical Reaction Networks, CRNs, that are capable of history-dependent functions (giving rise to behaviors such as synchronization, resonance and adaptation). My design uses a microfluidic platform to couple simple bistable reaction networks into inter- and randomly connected CRNs. The simple means employed to create networks with tunable and scalable interactions will *i)* make the design of CRNs amenable for novel network computing methods, using principles of out-of-equilibrium chemistry, and *ii)* advance and further enable the design of intelligent materials. This work challenges the fundamental concept of computing as such networks are weaker in almost all aspects of conventional computers but may be stronger in adapting and learning. This unique effort is complementary to, and well-situated within, the very strong systems chemistry community in the Netherlands, allowing us—chemists—to ask questions such as "how energy-efficient can chemical computers become?", "how do molecules compute?", and many more in the uncharted area of out-of-equilibrium chemistry.

Albert Wong started his Tenure Track position at University of Twente. His research focuses on finding routes to explore, and demonstrate, the operating principles in networks of interacting molecules under out-of-equilibrium conditions. He developed strategies for the de novo design of chemical reaction networks during his Ph. D. at Radboud University, with prof. dr. Wilhelm T. S. Huck. He then worked with prof. dr. George M. Whitesides as a Rubicon postdoctoral fellow at Harvard University, where he branched off into examining how simple but prebiotically relevant types of chemical reactions can self-assemble into complex networks.
For more info: https://www.utwente.nl/en/tnw/crn/