AMPERE Newsletter

Trends in RF and Microwave Heating

https://www.ampereeurope.org/newsletter/

Issue 103 **July 17, 2020**

In this Issue:

ISSN 1361-8598

Obituary
Dr. Milan Hájek
1941-2020

Dr. Milan Hájek, leading research scientist of the Institute of Chemical Process Fundamentals of the Czech Academy of Sciences, died on Monday, June 15, 2020, after a fatal heart attack at the age of 78.

We are very saddened by the departure of this highly remarkable chemist, excellent scientist, and enthusiast of microwave technologies. He was the true father and mentor of the Microwave Chemistry in the Czech Republic.

Milan Hájek was born on August 25, 1941, in Trpisov, Czechoslovakia. He obtained a diploma in chemistry from the Technology University of Pardubice in 1963. In 1968, he gained a Ph.D. in chemistry in the field of heterogeneous catalysis from the Institute of Chemical Process Fundamentals (ICPF) of the Czechoslovak Academy of Sciences. After two positions of Visiting Professor with the University of Caen, France (1969) and Central University of Venezuela, Caracas, Venezuela (1970-1972) he returned to Czechoslovakia. At the ICPF he set up a research group (1972-1992) working on the development of new catalytic technologies, such as the production of cinnamic acid from styrene and the synthesis of pyrethroids. Under a European Community grant (TEMPUS, 1991-1992), he taught homogeneous catalysis courses at six European universities (Montpellier, Toulouse, Giessen, Barcelona, London, Swansea). In 1992, he founded the Microwave Laboratory at ICPF and became a promoter of microwave energy in chemistry, especially in catalysis. His main scientific interests have become the microwave activation of chemical reactions, the study of microwave effects, and new industrial processes. His first industrial application of microwaves in 2000 led to the formation of the company Microwave Glass Technology (MWGT) Co. Ltd. in Liberec, where he worked as a technical director. A great success in applied research was the microwave technology of glass melting, basalt melting for the subsequent production of fibers, drying of books after floods, and total recycling of PET bottles for terephthalic acid. These results have been protected by several Czech and International patents.

The Microwave Community mostly remembers Dr. Milan Hájek from the “1st International Conference on Microwave Chemistry”, which he organized in Prague, 6-11 September 1998. The conference was attended by 140 delegates from 32 countries and attracted 7 exhibitors. According to the responses, this meeting was a great success, both scientifically and socially. Most foreign participants met in Prague for the first time. Its peculiarity was the Open Day, when lectures and the exhibition could be seen by all those interested.

The inability to "abandon the idea" was the driving force behind the organization of the “3rd International Conference on Microwave Chemistry” on 3-7 September 2006 in Brno, Czech Republic. The conference took place to celebrate the 20th anniversary of the first experiments in microwave organic synthesis performed in 1986, which heralded the new scientific discipline of Microwave Chemistry. The conference was organized by Masaryk University in Brno (Prof. Milan Potáček) in collaboration with ICPF (Dr. Milan Hájek) and endorsed by AMPERE. There were 75 attendees, mostly young chemists and PhDs from 22 countries

and included 3 exhibitors. The conference was again a great success and all participants were satisfied; Dr. Milan Hájek as well - a job very well done.

Dr. Milan Hájek was included in the Encyclopedia 2000 Outstanding People of the 20th century. He has been awarded several times during his life, e.g., Golden Crystal 1999 for a New Glass Melting Technology (Silicium Bohemica 99), Honorable mention for the Microwave Glass Furnace (Innovation 99), Glass prize 2001 for the application of microwave heating in glass melting (Czech Glass Society). In 2016, he received the Frantisek Krizik Honorary Medal for contributions in the field of technical sciences and for the implementation of the results of scientific research.

Dr. Milan Hajek's studies contributed to substantial progress in the use of microwave chemistry and technology in material and chemical processing. He wrote more than 80 journal papers, over 90 Czech and International patents, and had over 100 contributions at international conferences.

Dr. Milan Hájek was a member of the Czech Chemical Society (1978), New York Academy of Sciences (1994), AMPERE - Association for Microwave Power, Education and Research in Europe (1994), Licensing Executives Society International (1996) and National Geographic Society (1996).

Colleagues from the microwave community said (alphabetically):

- Prof. Darek Bogdal (Cracow University of Technology, Poland) "It is very sad news, I liked Milan and his attitude to people. We are very sorry."
- Prof. Cristina Leonelli (University of Modena & Reggio Emilia, Italy) "Those who had met Milan will never forget him, his humanity and knowing him was a great experience."
- Prof. Frank Marken (University of Bath, UK) "The news is very sad and I am sure Milan will be missed by his family and his colleagues alike."
- Dr. Marilena Radoiu (Microwave Technologies Consulting, Lyon, France) "Milan was a great human being and he will be sorely missed... Milan was such a kind mentor and I will always remember him for his smile and his tireless energy - nothing ever seemed to slow him down! Let us all send our prayers to Milan's family and friends to find the peace and strength that comes in knowing that a loved one has gone to their eternal rest."
- Dr Ricky Metaxas (St John's College, University of Cambridge, UK). "Milan was always very kind to me and his participation in the biennial AMPERE conferences benefited most of the membership. All in the AMPERE community will be sad to hear of his untimely death. Personally, I will always remember the few days I spent in Prague in 1997 to discuss his pending international conference on microwave chemistry. He and Katerina had arranged an overnight stay at their country house where Margaret and I enjoyed a pit barbecue in the delightful grounds. Quite a memorable occasion."
- Dr. Edward Reszke (Ertec-Poland) "I will remember Dr. Hajek as a real patron of microwave technologies and I am glad to put my back into his research from which I have also benefit. Let his life be remembered well!"
- Dr. Chris Strauss (Australia) "He was a great friend and role model to all of us, as well as a staunch, hard-working and dedicated advocate for all of us, since the very early days of microwave chemistry. He was a gracious and generous host and he died too young."
- Prof. Didier Stuerga (University of Burgundy, Dijon, France) "There is hardly anyone left trying to understand microwave chemistry!"
- Dr. Rajender Varma (Environmental Protection Agency, USA) "I am really shocked and sad to hear this dreadful news."

Dr. Milan Hájek leaves behind his wife, Katerina, his son Alan, his daughter Katerina, and his two grandchildren.

Dr. Vladimír Církva
Institute of Chemical Process Fundamentals of the Academy of Sciences, Prague, Czech Republic

Marilena Radoiu
Microwave Technologies Consulting, Lyon, France

*Behavior and Modelling of the Vibrational-to-Translational Temperature Ratio at Long Time Scales in CO_2 Vibrational Kinetics**

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Non-thermal microwave plasma reactors can efficiently split the CO_2 molecule. However, big challenges remain before this technology becomes a feasible industrial technology. Computer modelling can be very useful to tackle such challenges. Detailed kinetic modelling is commonly used to get insights into the complex vibrational kinetics of CO_2 as vibrational excitation is strongly related to the energy efficiency in the dissociation process. The vibrational-to-translational temperature ratio has been identified as a key variable to achieve high energy efficiencies and has also been used to simplify detailed CO_2 vibrational kinetics, notably reducing the number of species and reactions required to model the non-thermal plasma.

In this work, we have used a reaction kinetics model to study the vibrational kinetics of CO_2 plasma under the different conditions typically used in CO_2 dissociation experiments in non-thermal microwave plasmas and we showed that Treanor-like vibrational distribution functions can be obtained at low gas temperatures even if vibrational-to-translational (VT) relaxation is included in the calculations. We have also pointed out that symmetric sublevels can play an important role in defining the vibrational distribution function. In fact, at some conditions the vibrational temperature can almost double when VT relaxation of symmetric sublevels is accounted for in the model.

A timescale analysis of the collisional processes based on the first asymmetric vibrational level was performed to get insights into the behavior of the vibrational kinetics. It was found that, in general, vibrational-to-vibrational (VV) relaxation is the fastest process and VT relaxation of asymmetric levels is the slowest process throughout the studied conditions. Moreover, it was found that the VT relaxation of symmetric sublevels limits the intermode vibrational-to-vibrational (VV') relaxation process. Likewise, at high temperatures, the VT relaxation of asymmetric levels is hindered by the VT relaxation of symmetric sublevels, particularly the VT relaxation of asymmetric sublevels that proceed through the formation of symmetric sublevels b or c. Symmetric sublevels are formed in VV' and VT relaxation reactions. Their subsequent VT relaxation takes place in a descending ladder fashion, being the relaxation of the lowest level a the slowest step in the process. Therefore, it is concluded that the relaxation of symmetric sublevels slows down the relaxation of asymmetric levels and can lead to Treanor-like vibrational distribution functions and higher vibrational temperatures.

We also showed that, while T_V may increase with the gas temperature, the ratio T_V/T decreases with the gas temperature in the studied range of electron temperature and density values. It was also shown that above certain values of gas temperature, the VT relaxation is dominant; no vibrational excitation is attained and thus $T_V = T$. At sufficiently high electron densities, the limit at which the ratio T_V/T becomes 1 is when thermal equilibrium is reached and $T_e = T = T_V$.

Furthermore, we demonstrated that the behavior of the ratio T_V/T with increasing gas temperatures can be fitted to an expression that incorporates the Landau-Teller temperature dependence of VT relaxation (See Figure below). The fittings were evaluated by computing the Adjusted R-square and the Root Mean Square Error (RMSE), yielding both very good results in the gas temperature range of 300-1500 K. Within this temperature range, the average Adjusted R-square is higher than 0.99 and the average Root Mean Square Error (RMSE) is smaller than 0.22. It is to be noted

however, that at temperatures higher than 1500 K, the quality of the fittings decay, although the trends remain correct and the fitted curves approximately match the results of the vibrational kinetics model. This expression can therefore be used to approximately predict the ratio T_V/T at timescales longer than ~10^{-5} s, as VT relaxation proceeds and the gas temperature increases, particularly for ionization degrees greater than 10^{-6} and gas temperatures lower than ~1500 K.

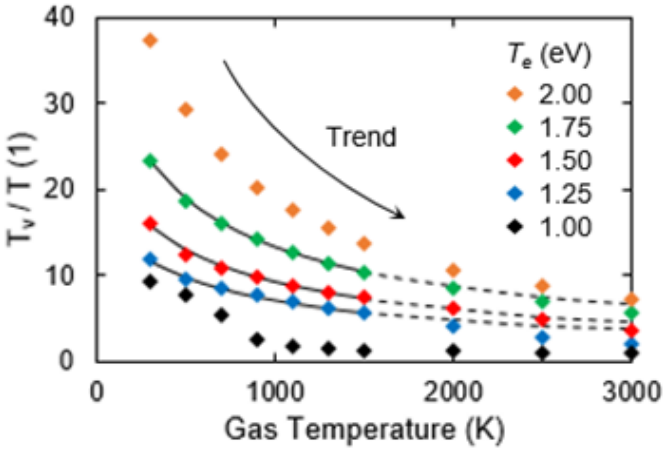

Figure: The long time scale behavior of the vibrational-to-translational temperature ratio in a CO_2 microwave plasma can be described by a simple function of temperature: $T_V/T = \frac{A}{T}\exp\left(\frac{B}{T^{1/3}}\right)$ with A and B being fitting parameters.

As the gas temperature increases the non-thermal degree decreases in a very similar way for all electron temperatures. However, at a very low ionization degree (T_e=1 eV), the rates of vibrational excitation are also very low and for temperatures higher than ~1000 K the VT relaxation completely dominates and $T_V = T$ (see black diamonds).

*** This work is published with the following bibliographic information:**

Moreno Wandurraga S.H., Stankiewicz A.I., Stefanidis G.D., "Behavior and modelling of the vibrational-to-translational temperature ratio at long time scales in CO_2 vibrational kinetics, *Reaction Chemistry & Engineering*, 4, 2108-2116 (2019).

About the authors

Sergio Moreno received his mechanical engineer degree at the Universidad Industrial de Santander in Colombia. After 5 years working in the design, construction, and operation of process plants, he moved to the Netherlands where he received his MSc in mechanical engineering with a specialization in process technology from TU Delft. During his doctoral research at the Intensified Reaction & Separation Systems research group of TU Delft, Sergio developed novel approaches to model plasma reactors. After his doctoral research, he joined the Technology & Infrastructure segment of Evonik Industries AG.

Andrzej Stankiewicz received his MSc in chemical engineering from Warsaw University of Technology and PhD from the Industrial Chemistry Research Institute in Warsaw. He is Full Professor and Chair of Process Intensification at Delft University of Technology, the Netherlands, and former Director of TU Delft Process Technology Institute. With more than 40 years of industrial and academic research experience, he is author of numerous scientific publications on process intensification, chemical reaction engineering and industrial catalysis. Andrzej Stankiewicz is Editor of Chemical Engineering and Processing: Process Intensification (Elsevier) and Series Editor of the Green Chemistry Books Series (Royal Society of Chemistry). He was founder and first Chairman of the Working Party on Process Intensification at the European Federation of Chemical Engineering. He currently chairs the Board of the European Process Intensification Centre (EUROPIC). Current research interests of Prof. Stankiewicz focus on control of molecular interactions and intensification of chemical reactions using electricity-based energy fields (e.g. laser, microwave, UV).

Georgios Stefanidis is Professor at the National Technical University of Athens (NTUA). He holds a Diploma in Chemical Engineering from NTUA and a PhD degree in the same field from the University of Gent. He has co-authored over 100 peer review publications in the broad field of Process Intensification, mostly focusing on alternative energy forms and transfer mechanisms (mainly microwaves and plasma). He is currently one of the Editors of the Chemical Engineering and Processing: Process Intensification Journal (Elsevier), Vice-Chair of the EFCE Working Party on Process and is member of the scientific committee of the Association of Microwave Power in Europe for Research and Education (AMPERE).

Ricky's Afterthought:

COVID-19: The Pandemic that Brought the World to a Standstill

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It is not an exaggeration to say that the covid-19 has stopped the world functioning. This is a highly contagious desease with many symptoms but predominately a fever, dry cough and compromised breathing which was announced to the world by China on 31 December 2019. It is believed that wet markets (markets dealing with live animals) may have been the source of which finally mutated to infect humans. As we now all know, it is spread by droplets in the air, exacerbated by sneezing and coughing and also by touching surfaces which have been contaminated with Covid-19 and which can remain contagious for up to 3 days.

During the past several months, practically the whole world has been in various stages of lockdown. Schools shut their doors, businesses stopped operating and travel restricted for all workers except those in essential areas fighting the virus: medical, health and care service staff. The only other businesses that were allowed to remain open dealt with food production and its distribution to keep the world fed and transport to support essential workers. The economic impact of this will be devastating, many businesses have already gone under and some large ones also are warning that they too may cease to operate altogether or at least will be forced to make many of their workers redundant. Some economists predict that unemployment rates in the UK by the end of this calendar year may reach up to 10% while the EU predicts that the region will contract by as much as 7.4%, which is worse than the economic shock of the 1930's. The ensuing recession, lasting a number of years, will have a devastating effect on our wellbeing. Putting it bluntly, it will very likely cause economic paralysis and mass unemployment.

People all over the world are asking a simple question: "Could all this have been foreseen and therefore measures taken to alleviate the effect?" We may think that killer viruses, plagues and pandemics are extremely rare but here is a list of the most virulent since Plato's and Socrates' time which will be discussed in a book to be published later this year on pandemics by Dr Liam Fox, a medic and former cabinet member of the British Government.

- The **Plague of Athens** around 430 BC killed up to a third of Athenians during the Peloponnesian war.
- The **Antonine Plague** around AD (165-180) wiped out inhabitants of Rome by returning troops bringing back a smallpox-like plague with the emperor Marcus Aurelius Antoninus a victim.
- The bacterium yersinia pestis carried by flies was responsible for the **Justinian Plague** (541-549) AD, which wiped 1/3 to ½ of all Europeans, initially spreading through the Byzantine Empire.
- The **Black Death** which is believed to have killed 30-60% of the world's population took place during (1347-51) AD and was due to the bacterium yersinia pestis.
- Europeans arriving in the Americas brought with them deseases such as flu, smallpox and measles, which wiped out nearly 90% of native Americans. It started around 1492 and is termed the **Columbian Exchange**.

- The bacterium yersinia pestis strikes again during the **Great Plague of London** of 1665 AD killing a quarter of all Londoners.
- Bubonic Plague starts in Yunan, China, (1855-1859) and spreads all over the world killing one million people. This is referred to as the **Third Pandemic Plague**.
- The **Russian Flu** in (1889-90) kills up to a million people in the northern hemisphere aided by transatlantic travel by rail and sea
- The **1918 Flu pandemic** after the WW1 caused by the influenza H1N1 kills 50 million people, old and young alike. By the way, Spain was neutral and had not imposed any censorship in the media so its newspapers were free to announce the pandemic which had originated in France and were free to announce the grave illness of King Alfonso XIII, so many people erroneously coined the term **Spanish Flu** for this pandemic.
- The **Asian Flu** of (1957-8), caused by the influenza H2N2, started in China and quickly reached Europe and America and only killed 1-2 million because a vaccine was quickly developed.
- The **Hong Kong Flu** of 1968-70 was a sub-strain of H2N2 but lower numbers of killed people are recorded because many were exposed to the Hong Kong Flu, developing antibodies which gave them immunity.
- The **Bird Flu** known as H5N1 during 1997-2000 in Hong Kong and spread to humans. The disease was curtailed by killing millions of birds.
- The **SARS** (Severe Acute Respiratory Syndrome) **epidemic** was detected in 2002-3 and is a form of coronavirus. It spread to around 8000 people with 10% dying of it. The World Health Organization (WHO) warns that this virus may strike again in the near future.
- The **Swine Flu** of 2009-10, was detected in Mexico and is once again due to the influenza H1N1 but due to a rapid lockdown it affected few people.
- The **Ebola outbreak** started in Africa and caused little over 11000 deaths by acting extremely quickly.

We cannot therefore claim that we have not been warned regarding a new pandemic such as Covid-19. Governments should have been better prepared to deal with such an eventuality and it is true to say that some did, such as South Korea, Germany, some of the Baltic states and Greece for example. Warnings by eminent scientists and medical experts, first sounded after Wuhan was locked down in January 2020, should have been taken extremely seriously. In fact, the lack of preparedness so exposed by the shortage adequate PPE (Personal Protection Equipment) such as gloves, masks and overalls is hard to understand. Initially some advisers were postulating that we ought to fight this pandemic using the **herd immunity** approach: by offering up the population to become infected thereby, ensuring a majority would be only slightly affected thus building substantial immunity to the virus. This was, however, a very dangerous approach as it might have entailed an unacceptable number of deaths and also there was (and still is) no evidence that people who had suffered the virus would have lasting antibody immunity. Also, such an approach may have overwhelmed the hospitals as there were not enough intensive-care beds to accommodate those infected.

A measure of how the virus spreads is given by a factor R (reproduction rate) hoping that this will be $R<1$, meaning that every person who has contracted the virus affects less than one other person. However, in many countries it quickly transpired that $R >>1$ rapidly approached $R=4$. Such an exponential increase squashed the idea of allowing a herd immunity to build as the number of deaths showed a rapid rise forcing the governments to order social distancing and staying at home except for purchasing food, medicines and allowing the not too vulnerable the occasional walk for exercise. In early May in the UK the reproduction rate was within 0.6 and 0.9, in other words just about safe but much lower limits were sought.

So apart from a very small number of countries, such as Sweden for example, we were all in a state of perpetual lockdown, putting our homes to order, carrying out small DIY jobs that were neglected over the years and finding ways to communicate with students, families, friends and colleagues using Zoom, Skype, Teams and other similar media platforms. To use Shakespeare's expression in "A

Merchant of Venice", over the past few months we have waited with **bated breath** the daily briefing from the Government informing us of the number of people who have succumbed to this deadly disease with some of us plotting our own daily deaths against time on an Excel spreadsheet or, better still using the old fashion way of graph paper and pencil, hoping that the curve flattens to show a downward trend which gradually it has. At the time of writing the Statista website gives an interesting toll of fatalities as shown below:

Table: Coronavirus (COVID-19) deaths worldwide per one million population as of July 15, 2020, by country [1]

	Confirmed deaths (absolute)	Population (in millions)	Deaths per million
Belgium	9,787	11.42	856.85
United Kingdom	44,968	66.49	676.32
Spain	28,409	46.72	608.02
Italy	34,984	60.43	578.91
Sweden	5,545	10.18	544.53
France	29,943	66.99	447
USA	136,284	327.17	416.56
Peru	12,229	31.99	382.28
Chile	7,069	18.73	377.43
Ireland	1,746	4.85	359.74
Netherlands	6,135	17.23	356.04
Brazil	74,133	209.47	353.91
Ecuador	5,130	17.08	300.27

It is interesting to note Sweden's position given that the authorities did not adopt a lockdown policy, relying on herd immunity to combat the virus. Such data are of course still being obtained and no doubt, the order in the above table will change as different countries adopt different policies to combat this virus.

While huge efforts are currently taking place in a number of countries to finding a vaccine the one aspect on which all Governments agree is boosting their test and trace facilities, initially focussed on front-line staff, care workers and staff in essential businesses and eventually to the wider public. Labs all over the world are desperately trying to design a molecule that destroys the virus with a number concentrating on RNA which is capable of instructing the body what proteins to produce. The link between antibodies and immunity is still to be achieved. Some efforts have reached the pre-clinical and clinical trials but realistically we are a long way to first finding a vaccine that works and then manufacturing it the vast scale required to benefit mankind. Of course, regulatory bodies such as EMA (European Medicines Agency) as well as the FDA (Food and Drug Administration) in the USA have to approve the vaccines once clinical trials have been performed.

A number of small private companies have switched their operations in order to contribute towards fighting the corona virus by altering their production to make PPE and other companies produced equipment to check whether a person has contracted the virus. I came across a paper published in late April stating that scientists at Manchester University's Graphene Engineering Innovation Centre had developed a graphene-based biosensor that can detect SARS-Cov2 (Covid-19 virus) at concentrations as low as 1 femtogram/ml (that's a thousandth of a picogram!) Using a graphene field-effect transistor (GFET), the sensor can make highly sensitive, instant at point-of-care diagnosis for virus and antibody testing [2]. That is the kind of effort that brings people together in times of global crisis.

The energy sector is facing new challenges coping with the huge reduction in electricity due to Covid-19 trying to balance conventional and renewables power stations.

By the beginning of June, some countries were able to lift some of their restrictions giving greater freedom for people to leave their homes, exercise more frequently and for some sporting activities to take place, golf being an example which everybody accepts is the safest as you play with your own ball and need have no contact with your partner. Some European countries have allowed coffee places and some schools to reopen and visitors from the least affected countries to visit their touristic places, such as the Greek islands. The universal advice remains to continue to observe safe distancing and to wear of masks when using public transport.

One does not need a crystal ball to anticipate that life as we know it post-pandemic will be somewhat different with some restrictions lasting for

years or until an effective vaccine is found and tested and available on general release. Working from home will become more the norm as CEO's and their workers realize that there is no need to pay extortionate office rents when you can be as effective carrying out your work at home. There were reports that this was already happening in Silicon Valley. Of course, with only a fraction of people travelling on aeroplanes, trains, buses and on cars the big winner during the current lockdown is the environment where pollution levels have dropped dramatically since the beginning of March. However, as sure as eggs are eggs, when restrictions are finally lifted, we will no doubt revert to our bad old ways and start once again polluting our skies. But one thing is for sure, many companies will not survive and those that do will adopt different scenarios while governments may have to inject substantial funds into new infrastructure projects to boost employment.

What about the educational sector? It is muted that even next October we may find that many universities worldwide may still be closed and online teaching may continue. I have just conducted an online examination using Microsoft Teams on a fourth-year undergraduate manufacturing engineering student that I was asked to supervise on a microwave vacuum project where the student presented her work and myself and her internal supervisor quizzed her before finally assessing her. However, prospective students are starting to question why they should pay substantial fees to universities when one cannot benefit from meeting face to face with the dons and benefit from their extensive knowledge and unique expertise while also missing the camaraderie and networking with fellow students.

All this is speculative and the next few months will show whether easing of the lockdown and relaxing the restrictions throughout Europe was handled properly pointing perhaps to further lessening of the restrictions. The greatest fear is to have relaxed the restrictions too speedily without an adequate test, trace and contact process, which may result in a second peak of the virus in the months to come.

For further reading

1. https://www.statista.com/statistics/1104709/coronavirus-deaths-worldwide-per-million-inhabitants/
2. https://pubs.acs.org/doi/pdf/10.1021/acsnano.0c02823

IMPI 54 Symposium Held as Virtual Event for First Time in IMPI History

Molly Poisant
Executive Director, International Microwave Power Institute (IMPI)

The International Microwave Power Institute held their 54th Annual Microwave Power Symposium (IMPI 54) from June 15-18, 2020. The event, held virtually for the first time in the Institutes history due to the COVID-19 pandemic, brought together 85 attendees from 15 countries. Dr. Graham Brodie, University of Melbourne, served as the Technical Program Chairman for IMPI 54.

In March, IMPI faced a huge dilemma. The Symposium was to take place in June of 2020 in Savannah, Georgia, USA but an in-person event was not feasible given the safety concerns and travel restrictions brought on by the pandemic. IMPI's Board unanimously agreed to move the event to a virtual platform. All authors who had been accepted into the program were given the option to present at IMPI 54 or put their paper on pause until IMPI 55 (June 2021). Half of the authors chose to present virtually and so the program was redesigned to allow for 25 oral presentations spread over 4 days. All sessions were recorded and made available to attendees to address time zone concerns. Mr. John F. Gerling, IMPI Treasurer, developed a robust set of guidelines and instructions for the Zoom platform; working together with the IMPI 54 TPC Chairman, Session Chairs and technical hosts all authors attended practice sessions to ensure the event would run smoothly. Traditional attendance at the IMPI Symposium has been between 90-130 attendees in the past 5 years.

IMPI's President, Mr. Bob Schiffmann, shared the following, "This early recognition of the impact of the pandemic allowed us to negotiate cancellation, without penalty, of our hotel contract. Then began the hard work of putting together a virtual symposium. None of us had any idea of how difficult the task would be, but as we started working, the barriers and problems became clear. I can't thank enough the many persons involved in this effort, but let me begin with Graham Brodie, Molly Poisant, Alicia Standridge, John F. Gerling, Eric Brown, and kudos to the many other people involved in the planning and execution of IMPI 54."

IMPI 54 featured a keynote address by Dr. B. Reeja Jayan of Carnegie Mellon University and three invited papers: Dr. Josip Simunovic, NC State University & SinnoavTek; Mr. Steven Drucker, Droaster Laboratories; and Mr. John F. Gerling, Gerling Consulting. There were 21 additional oral presentations and a Solid State Cooking workshop, led by IMPI's Solid State RF Energy Section. Topic areas were clustered in 3-4 hour sessions and included: Industrial Processing, Modeling, Solid State, Microwave Equipment & Ovens, Food Processing and Food Safety.

Seven of IMPI's Corporate Members participated in a virtual Exhibitor Showcase and five students prepared posters that were made available on IMPI's website throughout the event. There were various networking opportunities offered throughout the week (i.e. virtual meet & greets, coffee breaks and a happy hour).

IMPI 54's Student Competition was held under the direction of Dr. Candice Ellison, Leidos/NETL, and seven students took part in the competition. Best Oral Presentation by a student was awarded to Mr. Yonas Gezahegn, Washington State University; Best Poster Presentation by a student went to Ms. Zhi Qu, Washington State University; and Honorable Mention was awarded to Mr. Yuhei Arai of Sophia University.

"We are delighted with the level of participation from the IMPI community," said Molly Poisant, IMPI Executive Director. "While we would have preferred to gather in-person, it was important to IMPI's Board of Governors that the event go on. As we look to the future with great hope that we can convene again soon, we feel better prepared to offer remote participation as warranted."

Plans are now underway for the 55th Annual Microwave Power Symposium, to be held at the DeSoto Hotel in Savannah, Georgia, June 28-30, 2021. The Call for Papers for IMPI 55 will open on September 1, 2020. Additional details can be found at www.impi.org

About the authors

Molly Poisant has served as the Executive Director of the Int'l Microwave Power Institute (IMPI) since 2010. She has over 25 years of experience in event operations, business development, legislative affairs and sponsorship sales having worked for two former Governors and several U.S. and international technology conferences. She received her Bachelor's degree in Political Science from Longwood University

Upcoming Events

18th International Conference on Microwave and High-Frequency Applications: AMPERE 2021
13-16 September 2021 | Gothenburg | Sweden

AMPERE 2021 is the largest event in Europe dedicated to scientific and industrial applications of microwave and radiofrequency power systems. The conference presents the status and trends in the multidisciplinary fields of microwave and radiofrequency heating, dielectric properties, material processing, high power systems and technologies. The AMPERE conference is a unique opportunity for the presentation and discussion of the most recent advances in the microwave technology and its applications. The conference provides many opportunities to researchers and engineers from academia and industry to exchange innovative ideas, networking, discuss collaborations and to meet with international experts in a wide variety of specialties of microwave and high frequency technologies at both scientific and industrial scale.
Website: https://www.ampere2021.com/

4GCMEA 2020 postponed to 2022, August, Chengdu, China
Due to the COVID-19 pandemic, 4GCMEA has been postponed. Representatives from 5 MAJIC associations had an online meeting and discussed about the postponement. The organizers finally made the difficult decision to shift the 4GCMEA from its current dates of 17-20 August 2020 to August 2022. The submission system will be closed. The Local Organizers will contact the authors to deal with the abstract withdrawing issues. A call for papers with new exact dates of 4GCMEA2022 will be distributed and the submission system is supposed to re-open at the end of 2021. All future deadlines will be re-scheduled accordingly. Those who have already booked the accommodation at CYNN hotel and/or have paid the registration/sponsorship/exhibitor fee, the conference secretary will inform them how the cancellation/carry forwarding/refunding will be handled for them**.** Website: www.campa.com.cn.

UIE 2020 is changed to UIE 2021, 1-3 September 2021, Plzen, Czech Republic
Based on the present situation in the world, strongly limited possibilities of traveling and other circumstances, after long considerations and discussions the Organizing Committee of the UIE together with its leading people decided for postponing the Conference to the year 2021. The Organizing Committee secured a new reservation of the conference venue and with pleasure, we can tell you all that the new term of this event is 1st – 3rd September 2021. In accordance with this decision, the Ph.D. course is also shifted and its term will be 27th August – 1st September 2021. Authors of already sent papers will be informed (through the conference system EasyChair) very soon about the possibilities what to do.
Related information and updates will be provided on a new website https://edison.fel.zcu.cz/html/uie2021

European Microwave Conference (EuMC 2020) – 10th-15th January 2021, Utrecht, Netherlands.
In light of the global pandemic and related measures imposed by the respective authorities, European Microwave Week (EuMW) organizers have decided to reschedule the event to 10-15 January 2021 in order to enable as many conference and exhibition visitors to join as possible.
The world-class event will be held in Utrecht, The Netherlands, and will encompass the 50th European Microwave Conference, the 15th European Microwave Integrated Circuits Conference, and the 17th European Radar Conference. The technical programme and exhibition will provide an opportunity for attendees to experience the latest products, research, and initiatives in the microwave sector.
Bringing industry and academia together, European Microwave Week 2020 is a six-day event, including three cutting edge conferences, three forums, and one exciting trade and technology exhibition featuring leading players from across the globe. EuMW is organized by Horizon House on behalf of the European Microwave Association (EuMA), an international non-profit association with a scientific, educational and technical purpose.
Website: https://www.eumweek.com/

The 2020 Asia-Pacific Microwave Conference (APMC 2020) On behalf of the organizing committee, the 2020 Asia-Pacific Microwave Conference (APMC 2020) will be held **virtually from 8-11 December**, 2020. It is organized by the IEEE AP/MTT Hong Kong Chapter, technically co-sponsored by the State Key Laboratory of Terahertz and Millimeter Waves (City University of Hong Kong), the Department of Electrical Engineering (City University of Hong Kong), the Department of Electronic Engineering (The Chinese University of Hong Kong), the IEEE AP-S, the IEEE MTT-S and the European Microwave Association. It is also supported by the Hong Kong Science and Technology Parks Corporation, IEEE Hong Kong Section, IEEE CES and IEEE OES. A broad forum will be provided for participants from both academia and industry to exchange research results and discuss collaborations in the fields of microwaves, millimeter waves, terahertz waves, infrared and optical waves during APMC 2020; such exchanges are key to accelerating the technology development in the Asia Pacific region. Prospective authors are invited to submit original papers on their recent works. Proposals for special sessions, workshops and short courses are also solicited.
Website: http://www.ee.cityu.edu.hk/skltmw/apmc2020/index.php

Recycling technology to introduce rubber from End-of-Life Tires into production lines as virgin rubbers substitute

Value-Rubber is an innovative rubber recycling technology for End-of-Life Tires (ELTs) which achieves the complete rubber devulcanization.

In Europe, more than 3 million tonnes of ELTs are generated every year. Current R&D efforts on the market are focused on downcycling applications to these granulated rubbers, since a full recovery of rubber that can be used in rubber industry as raw material, is still not feasible.

If the great potential of ELT rubbers is not exploited, this will lead to further waste of resources and a loss of competitiveness in Europe. The EU-funded VALUE-RUBBER project proposes a game-changing idea, betting on the high-risk innovation to fully recovering rubber from ELTs as a real substitute for virgin rubbers.

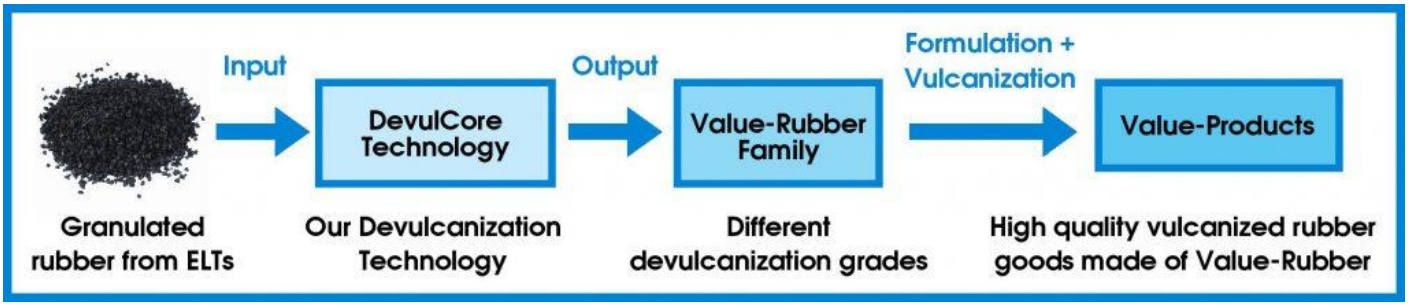

Figure 1: Scheme of the Value-Rubber process chain

Rubber is a key raw material for Europe, which is either a petroleum based synthetic rubber or imported natural rubber. Since 2008, the European Waste Framework Directive stipulated the mandatory recycling of ELTs. In Europe, more than 3 million tons of ELTs are generated every year and treated in several ways, split into: energy recovery (53%) and material recovery (47%).

DevulCore is a complete devulcanization technology which takes the most of two methods, mechanical plus a non-conventional heating. It permits both the strict control and the tuning of the devulcanization process parameters, being able of selectively breaking both the surface and non-surface C-S bonds, without breaking the main chain C-C bonds. The output is devulcanized rubber (Value-Rubber) with a range of devulcanization percentage

tuned as it may be necessary, up to 100% if desired. Value-Rubber can be used widely and is vulcanizable without the addition of virgin rubbers, while the properties of the source material are retained.

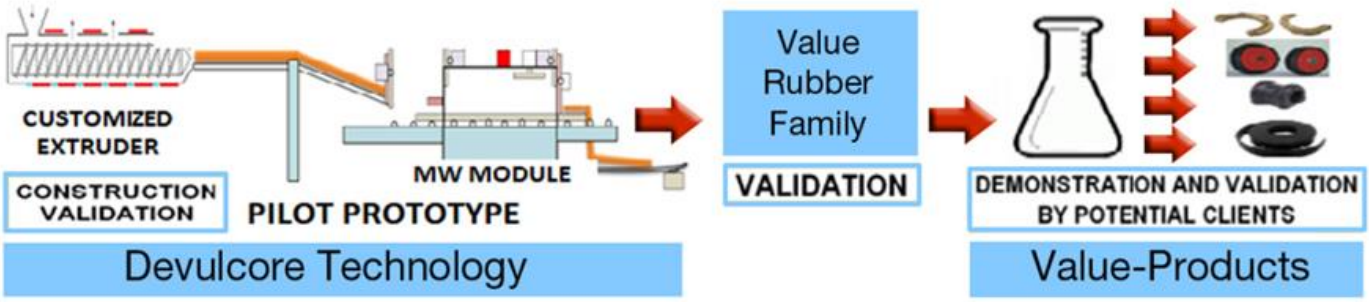

Figure 2: Project tasks and investigated technologies in Value-Rubber

DevulCore technology has already been demonstrated in relevant environment resulting in high quality products. The consortium business vision includes the commercialization of the DevulCore technology and the Value-Rubber products as well as the exploitation of the 1st DevulCore Plant. Such market-driven innovation will contribute to the EU circular economy and EU raw materials challenge, while it will both create a new market for ELT recyclers and fulfill demands of EU rubber goods manufacturers.

Consortium partners are working together in order to assure a successful development and further industrial stage of DevulCore, an innovative recycling technology of rubber from ELTs which achieves the complete rubber devulcanization. The end product is a recycled rubber, Value-Rubber, with a maximized potential to be used as a full substitute of virgin rubbers in conventional manufacturing processes.

The consortium consists of three companies as well as the Centro Tecnológico del Plástico y del Calzado (Murcia, Spain) and the R&D group Electromagnetismo y Materia of the Universidad Politécnica de Cartagena (Spain). The companies are the following:

- Synthelast (Elche, Spain) is dedicated to the transformation of thermoplastic rubber and polyurethane systems.
- Dymotec (Olen, Belgium) is dedicated to the design and construction of microwave systems for industrial use.
- Borflex (France) is dedicated to the formulation and production of rubber objects.

Acknowledgment

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870000.

Project website:

https://valuerubber.eu/
https://cordis.europa.eu/project/id/870000

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AMPERE Newsletter

ISSN 1361-8598

https://www.ampereeurope.org/newsletter/