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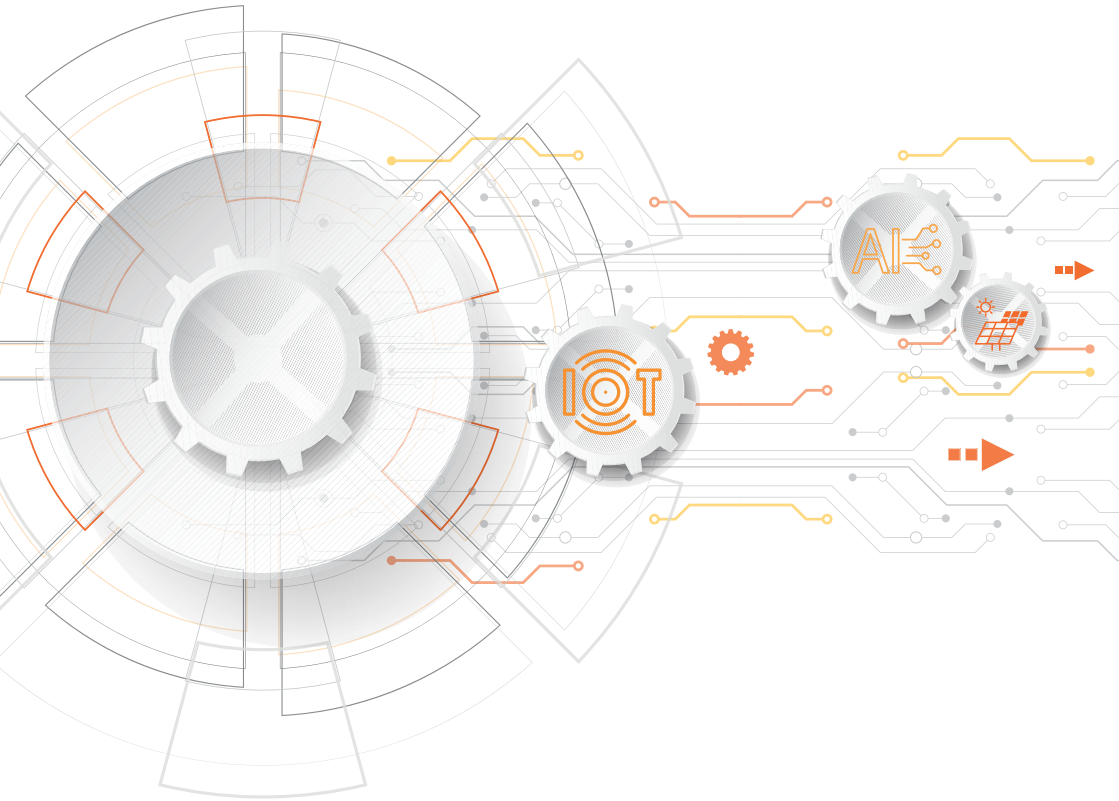

3rd Kuwait-imec Symposium

In Partnership with EnergyVille

Advancing our Societies with Digital & Energy Transitions

October 3 - 4 , 2023 - Kuwait

www.kfas.org/imec2023

Sustainability Through Knowledge

Overview

Advancing our Societies with Digital and Energy Transitions

3 - 4 October 2023

Digital transformation is one of the fundamental pillars of the Kuwait 2035 vision. By bringing together leading international and regional experts, this Symposium aims to explore the profound transformations occurring in our societies due to the simultaneous advancements in digital technologies and the transition towards sustainable energy systems.

The first day of the Symposium will delve into the strategic drivers and digital transition requirements of several diverse AI applications in areas such as healthcare, smart cities, sustainable food, and energy. A dedicated session on data sensing and Internet of Things (IoT) will discuss AI on small computers that are deployed in the wild (your thermostat, refrigerator, traffic lights, etc), and how information from these sources can be fused and interpreted. The session will close by discussing how digital transition technologies, such as IoT, and the energy transition towards sustainable sources converge.

The second day of the Symposium will continue exploring this convergence by illustrating how digital transition enables the deployment of a more sustainable energy system based on renewables. This will be followed by presentations on photovoltaic energy generation, a domain in which an intensive collaboration has been fostered between Kuwait University (KU) and imec/EnergyVille over the last decade. Results of this collaboration will be presented by KU and imec team with specific focus on the challenges faced by the hot and dry climate of Kuwait.

Marcel Zevenbergen

Program Manager at Oneplanet & Holst Centre

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Dr. Marcel Zevenbergen obtained his MSc from Delft University of Technology in 2005 and PhD from the same university in 2009.

He joined imec where he developed novel sensor platforms for various applications in close collaboration with industrial partners. Currently, he is Program Manager both at imec - Holst Centre and imec - OnePlanet leading the advanced sensor development for various applications ranging from precision agriculture and food production, artificial organs, organ-on-a-chip and bioreactor monitoring.

Preventive Health / Disease Interception and its Link with AI

Managing health instead of illness is a disruptive view of the future of healthcare: a focus on prediction, prevention or interception of disease rather than on disease management. This requires new sensing tools and digital twin models that provide individuals and their physicians/life coaches with detailed insights into their evolving health.

As many chronic diseases are linked to diet, microbiome, or immune responses, new tools are needed to monitor mechanistic effects in the gastrointestinal (GI) tract and gut-brain interactions which is difficult to access. What if we could create a device that makes gut health monitoring accessible to everyone, preventing GI-related problems turning into serious diseases, and diagnosing in a very early stage? imec-OnePlanet is developing ingestible sensors, enabling biochemical analysis, microbiome sampling for unprecedented insights in individual gut health, immune health, and mental health and companion tools that provide insights in diet and eating behavior.

The human digital twin platform simulates personal GI tract characteristics and digestion of specific foods, showcasing the relationship between lifestyle factors, gut health and (chronic) diseases and allowing for personalized prevention and treatment.

Sustainable Food & Environment and the Role of AI

The number of experienced growers is aging and diminishing, this is one of the key challenges in agri-food. Imec-OnePlanet focuses on the development of sensing technologies and digital applications (using AI) that enable smart precision farming and efficient food processing.

This will lead to autonomous growing where growers are being supported in their decision-making regarding growth and yield, while making use of resources as efficiently as possible and minimizing their environmental impact. Sensing solutions for autonomous indoor farms, food processing and instruments to create a digital twin of an orchard are presented.

Novel sensors are required that provide direct and real-time insights into the plant physiology or produce quality. Examples are non-destructive techniques that monitor the internal quality of fruits and vegetables, nutrient uptake and sensors that measure nitrogen emissions. In food processing, new sensing applications are envisaged for real-time monitoring of food quality and food safety.

Wouter Van Den Bosch

Program Manager Health & AI

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Wouter Van den Bosch is R&D Program Manager «AI & Health» at imec. Together with a highly motivated and capable team of data scientists, developers, domain experts and project leads, his team aims to push the boundaries of datascience, and AI applied to imec's technological roadmaps in the domains of Health and Life Sciences.

Before taking up this role, Wouter was Program Manager Public Health at Imec, helping to accelerate digital transformation and access to health data at scale in the Belgian health ecosystem & explore how technology can be used to create new insights in personalised and predictive health pathways.

Wouter is a seasoned technologist with a passion for innovation, disruption, collaboration and new technology applied well.

AI for Health in an Age of Bio-Convergence

For decades, deep technology and fundamental biology were on equally striking, but essentially separate evolutionary paths. One led to advanced materials, hardware and AI, the other to new insights into the basic building blocks of life, and impressive breakthroughs in the Life Sciences and Healthcare industries.

We are witnessing the moment where these scientific lineages intertwine and bring about a cross-fertilization involving the exchange of bits and molecules.

This bioconvergence promises to result in a Cambrian explosion of healthcare innovations, from allowing an unseen before view into our cells and new bio-manufacturing techniques to novel diagnostics and highly predictive and personalized therapeutics. It is in this *bio convergence* that imec sees itself as uniquely positioned to play an accelerating role alongside industry and academic partners.

On one hand, imec has extensive expertise in developing novel chips for next-generation -omics and sensing, imaging and more; on the other hand, imec boasts beyond-state-of-the-art research in artificial intelligence and advanced computational methods, many of it focused on health and life sciences specifically. The presentation will dive into how we organize Ai towards these opportunities, what challenges we face and what collaborations we seek.

Jan Adriaenssens

Director of Public Technology

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Jan Adriaenssens is director of public technology at imec. He explores which role technology can constructively play in society.

Jan studied mathematics (PhD) in Antwerp and philosophy (MSc) in London. He then gained experience with science and innovation policy at the Flemish government.

He next joined the research centre iMinds, which merged with the research centre imec in 2016, where he started as director of imec's smart city program ("City of Things").

As director of public technology, he directs imec's technological research in collaboration with the public sector, for example on topics such as cities, sustainability, mobility, and logistics.

How we can Enhance Cities and Mobility with AI

In it's ambitious smart city program "City of Things", imec gained extensive experience with the use of technology in the public space. How can we enhance life in cities by the careful and effective deployment of technology?

The first deployments of AI we noticed in the public administration, were all targeted towards automation of service counters, helping citizens navigate the interaction with the government. These chat-like functions are only scratching the surface of the huge potential AI has within the public sector and within the public space.

When we are looking towards the sensible use of digital technology and artificial intelligence in cities, we have to take a strong "use case /demand driven" approach. How to optimise urban mobility and logistics? How to make our cities more climate adaptive? Technologies in the public realm usually perform best when working in the background, quietly and effectively enhancing urban life, in an auditable, transparent, and privacy preserving way.

Tanguy Coenen

Data Technology Lead

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Tanguy Coenen is currently heading the data technology program at imec, focusing primarily on data spaces and digital twin technologies.

In addition to this, he oversees the edge AI projects within the Flanders AI research program. Prior to his current role, Tanguy held a strategic business development position within imec's digital transformation department.

He has accumulated experience in various areas of digital transformation, ranging from requirements co-creation, software development, to product management.

Tanguy obtained his PhD in Business Administration from Solvay Management School, with his research centering on "Knowledge sharing using social software."

Data Spaces and AI: Driving the Data Economy in Sectorial Ecosystems

The presentation delves into the transformative role of data spaces and AI in the data economy.

It explores how sectorial ecosystems are being redefined through the innovative utilization of data, giving rise to new business models and opportunities.

The investigation touches on how research in AI and data spaces is fueling these changes, forging new paths for economic growth and competitiveness. The interplay between data spaces, AI, and sectorial ecosystems, and how they collectively influence the ever-evolving data economy will be explained.

The talk will be beneficial to policymakers, industry leaders, researchers, and all stakeholders interested in harnessing the power of data for economic prosperity.

Tom De Schepper

Principal Member of Technical Staff

imec

Dr. Tom De Schepper obtained his MSc and PhD degrees in Computer Science from the University of Antwerp, Belgium.

He was part of the research group IDLab, as a sensior researcher and program manager, leading a team of 25 junior and senior researchers. He was involved in multiple national and international collaborations and was appointed challenge manager of the "Human-like AI" grand challenge in the Flanders AI research program, coordinating research across multiple Flemish research teams of different universities.

He has a background in wireless communication, distributed systems, and artificial intelligence. Dr. De Schepper is a co-author of more than 40 internationally peer reviewed publications.

Earlier this year, he joined imec as a Principal Member of Technical Staff, acting as the Scientific lead for Sensor Fusion and Edge AI part of the EDiT department (Enabling Digital Transformations), he is, among others, leading a sensor fusion project targeting the automotive realm.

Edge AI & Sensor Fusion: an imec Perspective

The last decade we have seen a massive increase in the popularity and capabilities of AI solutions, and expectations continue to rise.

We have seen stunning applications across all application spaces such as health, robotics, entertainment, and mobility. However, this vast popularity also has an important flip side. How stunning the results of AI may be, they come with a cost and it's one of computational complexity.

To realize this level of intelligence, machine learning algorithms require billions of operations behind the scenes. They are therefore extremely power hungry having a profound impact on cost and carbon footprint. In parallel, we are expecting more and more of these systems by adding, for instance, additional sensors to better perceive the world around them.

This split is unmaintainable in the long run. We thus need more intelligent and efficient solutions. Imec finds itself well positioned to tackle these challenges by combining expertise of hardware, sensor, and AI experts.

In this talk we will dive into the challenges of Edge AI and Sensor Fusion, discuss several research areas and the position of imec, and highlight concrete use cases and examples (e.g., in the fields of automotive and robotics).

Matthias Strobbe

Senior Researcher & Business Developer at IDLab

imec

Matthias Strobbe received his MSc and PhD degrees in Computer Science Engineering from Ghent University, in July 2004 and June 2011 respectively.

He is affiliated with research group IDLab, a core research group of imec with research activities embedded in Ghent University (Belgium).

He currently works as business developer and research project coordinator in the domains of smart energy grids and smart buildings. He is responsible for imec's living labs HomeLab and OfficeLab and worked on over 30 national and international research projects.

Dr. Strobbe is author and co-author of more than 35 papers published in international journals and conference proceedings.

Smart Energy Services for a Sustainable Society

Flexible services play a critical role in creating a more efficient, reliable, and sustainable energy system, they help balancing the supply and demand of different energy vectors, such as electricity and heat.

The ability to automatically control the demand of flexible loads can aid in reducing the stress on the grid, integrating more renewables and lowering required energy infrastructure investments.

IoT and AI technologies are key enablers to monitor, forecast and control the distributed assets (renewable generation, flexible and non-flexible loads, diverse storage systems, grid assets, etc.) that make up such a sustainable energy system.

The presentation provides examples of how data-driven AI techniques are used to model, maintain and control flexible loads and renewable energy systems, and how interoperability between the diverse range of assets can be improved, it also addresses the own energy consumption of these IoT, cloud and AI technologies.

Jeroen Buscher

Product Manager Electrical Storage

Vito / EnergyVille

Dr. Jeroen Büscher (PhD Physics, KU Leuven, 2010) was active as project manager at the Department of Electrical Engineering at KU Leuven from 2011-2016 with a focus on renewable energy technologies, smart grids and the integration of electric vehicles in low voltage distribution grids.

In 2016 he joined VITO within EnergyVille as product manager electrical storage. He is responsible for the development and execution of the roadmap on electrical storage technologies and services.

Jeroen is experienced in project management in an international setting and representing VITO/EnergyVille in various battery initiatives. Within EnergyVille he is research line coordinator for battery storage

Embedding Smartness in Batteries

Over the last 10-15 years, the world has been witnessing a strong introduction of batteries in the mobility and transport sector as well as in stationary energy storage applications to support the growth of renewable energy in the electricity mix.

The majority of new battery deployments in these markets rely on state-of-the-art lithium-based (Li-ion) technologies but battery material R&D is ever ongoing to bring forward better performing next generation Li-ion or alternative battery technologies.

However, once in operation there are still a lot of unknowns, that lead to sub-optimal use of batteries finally resulting in reduced lifetime and charging speed, safety critical events and uncertainties on battery state estimation.

This presentation highlights trends to improve on our battery understanding and use by the introduction of sensors and advanced battery diagnosis. It also positions EnergyVille's activities in the international landscape by the introduction of a disruptive sensor + battery management system approach that targets unexploited benefits for a growing share of stakeholders in the entire battery value chain.

Jozef Poortmans

Program Director of the PV & Energy Activities

imec / EnergyVille

Dr. Jozef Poortmans received his degree in electronic engineering from the Katholieke Universiteit of Leuven, Belgium, in 1985. Presently, he is Program Director of the PV and Energy activities of imec. In 2013 he was also appointed imec Fellow.

Since 2008 he is part-time Professor at the K.U. Leuven, where he teaches courses on photovoltaics and materials in electrical engineering. In 2013 he became also part-time Professor at University Hasselt where he teaches a course on analog electronics.

Since 2016 he is Coordinator R&D-strategy of EnergyVille, an institutional partnership between imec, VITO, KU Leuven and University Hasselt aiming at the development of technologies and demonstrations for the Energy Transition

Overview of the Collaboration Between Kuwait and imec/EnergyVille on Photovoltaics

The collaboration between Kuwait University (KU) and imec in the domain of Photovoltaics has started at the end of 2012 and 3 phases of 3 years each have elapsed since then.

The first phase focussed on building up the human expertise of KU in the domain of crystalline Si solar cell technology with emphasis on heterojunction devices and characterization as well as simulation of advanced Si solar cell architectures.

This resulted in advanced insights on the behaviour of the Si/a-Si:H heterojunction interface and the characterization of a-Si:H layers. In the second phase, the collaboration continued for Si and extended towards a new hybrid organic/inorganic material, perovskites, which has shown strong progress over the last decade increasing efficiency from nearly 0% to more than 25%, unseen for any other photovoltaic technology before.

The overarching theme of Phase 3 was to strengthen the role of KU in building up an improved fundamental understanding of the high-performance photovoltaic devices to create maximal value for Kuwait, Phase 3 also aimed at assessing and predicting the performance of Photovoltaic system in Kuwait conditions of irradiation, temperature and wind profiles.

These 3 phases pave the way towards the creation of a Renewable Energy Center in Kuwait based on human expertise and infrastructure built up in Kuwait during the different phases.

Gerrit Jan Schaeffer

General Manager

EnergyVille

Dr. ir. Gerrit Jan Schaeffer got his education in Business Studies, Applied Physics and Philosophy of Science and Technology at the University of Twente in The Netherlands.

After a career at the Energy research Center of the Netherlands (ECN) as a scientist and research manager he moved to the Flemish Institute for Technology Research (VITO) as Director Energy.

In 2016 he became an entrepreneur as CEO at Dutch Solar Energy in the Netherlands. Since 1 June 2021 he got the position as General Manager of EnergyVille, the main sustainable energy research institute in Flanders, Belgium.

The Energy Transition: Opportunities and Challenges

To stay below 1.5 °C global warming compared to pre-industrial times, the global economy should be decarbonized by 2050 and get to net-negative emissions after that.

Global carbon emissions are expected to peak around 2025, 25 years are left for a complete overhaul of the global energy system. Carbon-free technologies like wind and solar energy, batteries and electric vehicles have become available at ever declining costs, so a carbon-free future has become imaginable.

Deep electrification of the energy system and, where this is not possible, the use of green molecules are the main elements of a future clean energy system.

Energy efficiency, not only in products, but also in energy value chains, will be crucial to fulfill this energy transition on time. The new energy system will also imply a deep integration of the mobility, building, industrial and power sector.

Human resources, critical materials and changing geopolitical relations will be the main challenges to overcome. On the other hand, the economic opportunities and societal benefits are potentially huge for those countries that actively participate in and promote the energy transition.

The presentation will provide a sketch of the main challenges of the Energy Transition with specific attention to the opportunities for the Gulf Countries.

Hariharsudan Sivaramakrishnan Radhakrishnan

R&D Team Leader

imec / EnergyVille

Hari Sivaramakrishnan is currently the R&D team leader/ manager of the Wafer-based PV (WAFERPV) team in the PV technology & Energy systems group at IMOMEC (associated lab of imec at UHasselt).

The WAFERPV team is focused on novel technologies that enables PV integration in the urban environment (e.g., buildings, vehicles, infrastructure, agricultural farms), with novel interconnection concepts and module technology and reliability as its core expertise.

Hari is also responsible for project in-take, customer interfacing, resource management, R&D strategy roadmapping, Ph.D. supervision as well as management of multiple R&D projects.

Hari is an alumnus of Nanyang Technological University (NTU, Singapore, B.Eng, 2006, hons.), TU Delft (TUD, Netherlands, M.Sc., 2009, magna cum laude) and KU Leuven (M.Sc., Belgium, 2009, cum laude + Ph.D., 2014).

Hari has co-authored more than 50 publications and 2 patent groups. His interests and expertise range from kerfless wafering to heterojunction devices to integrated PV technologies.

Bringing Si PV-Technology to its Maximum Performance

Crystalline Si photovoltaic cells are approaching their theoretical and practical efficiency limits. The next Si PV cell technology node after the presently dominating manufacturing technology based on local rear contacts and well-passivated non-contact regions (PERC) is based on passivated contact regions to reduce the surface recombination at the ohmic contacts.

One has to distinguish between the high-temperature tunnel-oxide passivating contacts technology (TOPCon) and the low-temperature Si heterojunction technology (HJT). TOPCon is considered to be an evolution from PERC technology, and the industry has begun the transition from PERC to TOPCon at pace as of this year.

The HJT process flow is simpler and has the potential for higher efficiencies compared to TOPCon, but cost reductions (both OPEX and CAPEX) need to continue for HJT to be competitive.

In this talk, an overview of the state-of-the-art of TOPCon and HJT in research and industry will be given, touching on both the front/back contacted (FBC) and interdigitated back-contacted (IBC) designs. Additionally, it will be outlined which technology is best suited for which climate.

Moustafa Y. Ghannam

Prof. - Electrical Engineering Department

Kuwait University

Dr. Moustafa Ghannam received his BSc in Electronics and Communications Engineering Cairo University, 1975, DEA in Electronics from the Institut National Polytechnique, Toulouse, France, 1979, and PhD in Applied Sciences, Electronics from the Katholic University of Leuven, 1985.

He was a postdoctoral fellow at the EE Department, Stanford University between August 1985 and November1986. His major research interest is in silicon bipolar devices and solar cells.

From 1984 to 1993 he held a Senior Scientist position at imec. In 1993 he joined the Electrical Engineering Department at Kuwait University, where he is now Professor of Electronics since 2000.

Dr. Ghannam is author and coauthor of more than 50 refereed mostly Q1 journal papers, more than 100 international peer reviewed conference papers, and five book chapters, related to poly-Si and a-Si:H contacts in bipolar devices and solar cells.

He holds one US patent and two European patents and received several research awards from Kuwait University, Cairo University and Egypt. He served several terms as member of scientific committees of the IEDM, IEEE PVSC, IEEE Bi-CMOS conferences. He also served as EE editor of the Kuwait Journal of Sciences and Engineering and Guest associate editor for a special issue of Applied Science (MDPI) in 2020.

Heterojunction Devices and their Circuit Modelling

The presentation is dedicated to the heterojunction crystalline silicon solar cell with amorphous silicon passivated emitter.

The concept and required conditions for proper operation of such a cell including the role of the induced inversion layer emitter and the necessity of heavy free hole population in a-Si:H, in the inversion layer and of hole spill-over in the intrinsic a-SiH(i) spacer will be presented and discussed.

The fundamental problems encountered in such a cell and created by the presence of the thermionic barriers and their impact on the solar cell performance will be reviewed. These mainly include the cell series resistance enhancement under illumination related to the thermionic a-Si:H/c-Si barrier, and the cell voltage degradation associated with the TCO/a-Si:H Schottky front contact.

A comprehensive equivalent circuit model that takes into account the physical and material properties and their deficiencies as well as the cell design is proposed. The validity and accuracy of the model will be confirmed by comparing its predictions with experimental results.

Furthermore, the model is used to confirm and interpret simulation predicted and experimentally observed temperature dependence of the cell parameters and specific behaviour at low temperature such as S-shaped I-V characteristics and open circuit voltage saturation.

Yinghuan Kuang

Senior Researcher & Project Leader

imec / EnergyVille

Yinghuan Kuang received his PhD in applied physics in 2014 from the Utrecht University, The Netherlands. During his PhD he mainly worked on thin-film silicon solar cells.

From July 2014 till January 2018, he worked as a postdoctoral researcher at the Eindhoven University of Technology. There he was mainly involved in atomic layer deposition of thin films for perovskite solar cells. Since 2018 he is a project leader in the Thin Film PV group at imec.

He currently mainly leads perovskite materials and cell architecture development with stability and scalability for upscaling towards commercialization.

Perovskite Module Upscaling Towards Industrialization Based on Efficient Cell Architectures and Scalable Processes

In recent years, organometal halide perovskite-based photovoltaics (PV) have attracted great interest for their high energy conversion efficiency potentially at low manufacturing cost.

Despite the massive progress made by the community at laboratory small scale (typically at ~0.1 cm2 cell area), manufacturability at large scale (~m2) with stability and reproducibility remains very challenging.

In this talk, the most typical perovskite cell structures reported in the community and the current challenges will be reviewed, followed an overview of by the research facilities at imec for perovskite upscaling, including solution-based and vacuum-based material processes.

The highly efficient and stable perovskite cell structure design at imec which uses perovskite bulk and interface passivation strategies will be presented. The 30x30 cm2 perovskite module fabricated using scalable processes will also be illustrated along with the upscaling losses.

Yaser Abdulraheem

Assistant Prof. - Electrical Engineering Department

Kuwait University

Dr. Yaser Abdulraheem obtained his PhD in Electrical Engineering in the field of Ferroelectric Materials and Devices from University of California, Los Angeles (UCLA) in 2014.

As a faculty member in the Electrical Engineering Department at Kuwait University (KU), he was involved in the design of the Semiconductor Cleanroom facility at the new Sabah Al-Salem University City.

Dr. Abdulraheem was involved in establishing several research laboratories at KU, including the Nontechnology Research Facility (KUNRF), and the Semiconductor Research Facility (KUSRF).

Dr. Yaser was awarded several research grants and managed research projects funded by both Kuwait University and KFAS, most notably is an international collaboration project on the Development of Crystalline Silicon Based Solar Cell Technology, funded by KFAS between imec and KU since 2012.

Dr. Abdulraheem is also an academic advisor in the first national satellite project (KUWAITSAT-1). Dr. Abdulraheem has authored and co-authored many journal and conference papers in the fields of nano-scale materials science and engineering, ferroelectric materials and solar cell materials and devices.

The Perovskite lab at Kuwait University

Attention towards the development of perovskite solar cells has increased significantly over the past years mainly due to the enhancement in device performance and stability for long term terrestrial applications.

Device performance has seen a rapid and steady increase due to the success in hybrid tandem approaches where perovskite devices are coupled with lower bandgap substrates such as silicon or CIGS. Current records have exceeded 25%.

At KU, advanced facilities to fabricate perovskite devices for high performance applications were established. The presentation will demonstrate research capabilities at KU in the field of perovskite solar cell research and will highlight the approach towards designing and fabricating devices for cutting edge applications including the use of solar cells in space.

In order to find the most suitable perovskite composition to be used in space with maximum performance and stability, a very stable P-I-N device structure based on PTAA:Al_2O_3/ C60:BCP layers for charge transport will be used.

By keeping the same device structure and processing methods (solution-processing and thermal evaporation), devices will be measured for their optical and electronical properties under simulated space conditions to reach a better understanding about performance and degradation mechanism of perovskite solar cell with different active layers for space applications. The full description of material used, device processing and structure will be provided.

Arnaud Morlier

Team Leader R&D Energy Systems

imec / EnergyVille

Dr. Arnaud Morlier obtained his PhD in 2011 at the university of Grenoble in the French Atomic and Alternative Energy Commission Labs CEA INES after he completed his studies in materials engineering.

During his PhD, he developed gas barrier flexible composites for the encapsulation of printed electronics.

Between 2011 and 2022 he worked as senior scientist at ISFH in Hameln, Germany. His domain of activity encompassed module technology from design optimization to the lifetime and failure assessment in the field.

Since November 2022, Arnaud Morlier is employed as the team leader for the energy systems team at Imec in Energyville, Genk.

Modelling of PV-Systems

Energy yield modelling can be used to detect abnormal power degradation of a photovoltaic system, on the module level as well as on other system components depending on external factors.

To do this, it is necessary to determine the “natural” degradation rate of a system under given climatic conditions.

A physics-based approach will be presented to model the degradation rate/lifetime of Photovoltaic (PV) module considering various aspects that might influence the PV reliability, such as temperature, humidity and solar irradiation.

Furthermore, the ability to model the energy yield of a PV modules string allows to predict the thermal load and potential premature aging endured by an inverter connected to it. This element can be added to a general plant aging model.

Bader Aldalali

Assistant Prof. - Electrical Engineering Department

Kuwait University

Bader Aldalali is an Assistant Professor of Electrical Engineering at Kuwait University.

Dr. Aldalali completed his BSc from Purdue University in 2005, and his MSc and PhD from the University of Wisconsin-Madison in 2009, and 2013 respectively.

His PhD thesis was titled "Microlenses and their applications in microcameras". Dr. Aldalali is an active member of the KU-imec collaborative research team in the KFAS funded Advanced Silicon Photovoltaics research project.

Dr. Bader is interested in Energy yield modelling of silicon based photovoltaics and in the optimization of photovoltaics for Kuwait.

Overview of Kuwait University-Activities

One of the main culprits of the drop in efficiency as well as the degradation of photovoltaic (PV) modules in Kuwait over time is the high operating temperatures of the modules.

Reported efficiencies of the PV modules are obtained by testing them at standard testing conditions (STC), that is, at an ambient temperature of 25.

The rule-of-thumb is that for every 1 degree increase in cell temperature above STC, the efficiency drops by a minimum of 0.3% of the reported value. Such rules-of-thumb, in addition to the nature of heat dissipation from PV modules, are the heart of most energy yield frameworks in use today.

The main mechanism of heat dissipation from the cells, assumed in most energy yield models, is natural convection, often to stagnant atmospheric air at that STC.

The research at Kuwait University is mainly focused on the effect of wind on the temperature of the PV modules through two activities: the first is by studying the influence of forced convection in PV energy yield models, the second is focused on guiding the wind to decrease the temperature of the panels through the use of "guiding vanes".


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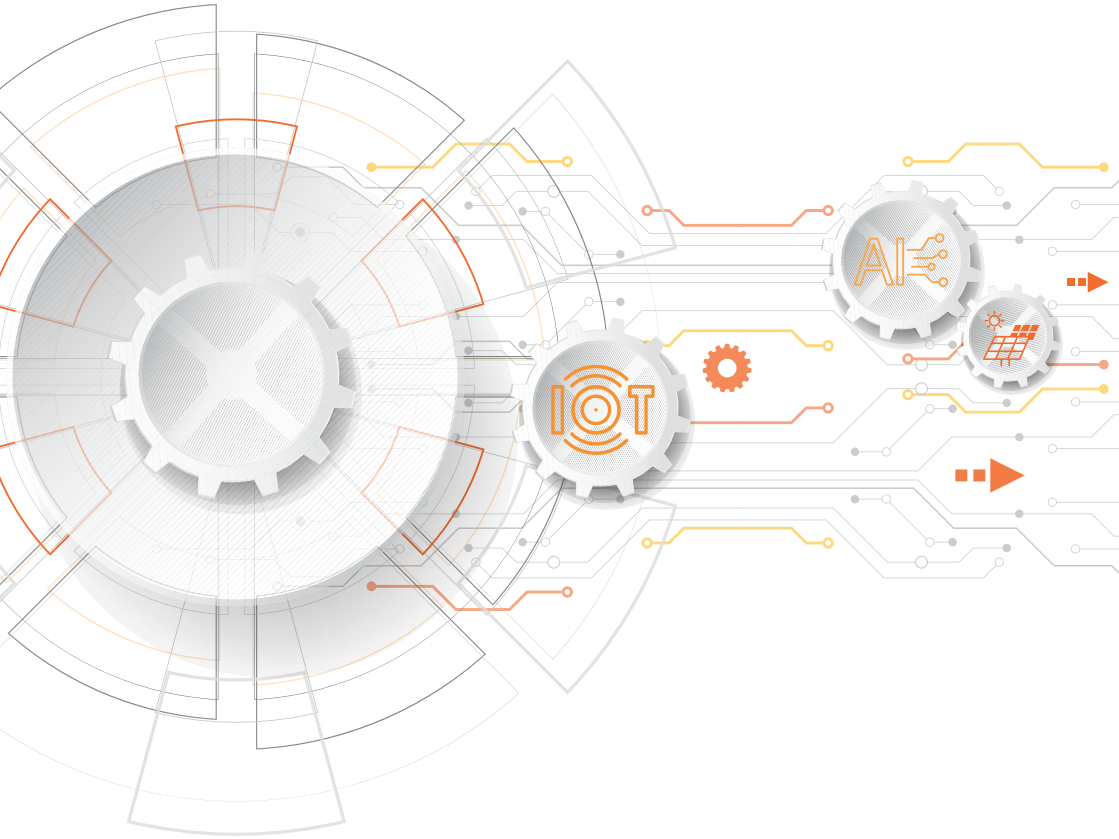

Telephone: +965 2227 81 00
Fax: +965 2227 04 21
Address: Ahmad Al Jaber St., Sharq, State of Kuwait
P.O.Box 25263, Safat, 13113 Kuwait
Email: info@kfas.org.kw
www.kfas.org