WMF 2019 – KEY TAKE AWAYS

12-14 JUNE 2019 – NANCY, FRANCE

WORLD MATERIALS FORUM

"We look forward to welcoming you in Nancy for our 5th edition that will be dedicated to **The Future of Materials: let's make it happen!**"

Philippe Varin, Chairman World Materials Forum
Victoire de Margerie, Vice Chairman World Materials Forum

Opening debate on smart materials for water management

- Jean Louis Chaussade, CEO Suez (France) – Co-chair
- Ilham Kadri, CEO Solvay (Belgium) – Co-chair
- Amanda Gwyther, Vice President Water Treatment, Xylem Inc (USA)
- Peter Voigt, Founder CleanTeQ (Australia)
- Moshe Kelner, CEO MemTech (Israël)
- Helge Daebel, Director Emerald Technology Ventures (Switzerland)

Measuring our Progress on Using Materials Smarter, Less and Longer

- Osamu Masuko, CEO Mitsubishi Motors (Japan) – Co-chair
- Pierre-André de Chalendar, CEO Saint Gobain (France) – Co-chair
- Brett Olsher, Former Partner Goldman Sachs (UK)
- Vincent Bamberger, MD Arthur D Little (France)
- Musa Salah, Director CSR, Ecobank (Ghana)
- Cécile de Guillebon, Global Director Facility Management, Renault Nissan Mitsubishi Alliance (France)
- Eisaku Ito, Deputy CTO Misubishi Heavy Industrie (Japan)

Materials Efficiency of the Electronics Supply Chain

- Greg Mulholland, CEO Citrine Informatics (USA) – WMF Grand Prix 2017 – Chair
- Shi Weiliang, General Director Huawei France (China)
- Harry Lehmann, Deputy MD, German Environment Agency (Germany)
- Bas de Leeuw, MD, World Resources Forum (Switzerland)
- Rebecca Gordon, Head of Non Ferrous Metals CRU (UK)
- Zack Boorstein, Senior VP Wisetek (USA)

Materials Efficiency thanks to Autonomous Vehicles

- Patrick Koller, CEO Faurecia (France) – Chair
- Maxime Picat, Executive VP Europe PSA (France)
- Philip Taynton, Co founder and CTO, Mallinda (USA)
- Tim Swords, President Industrial Business Hexcel (USA)
- Simon Verghese, Lidar Systems Manager Waymo (USA)

Assessing Criticality of Materials with special focus on Geopolitics

- Robert Friedland, CEO Ivanhoe (Canada/Singapour) – Co-chair
- James Litinsky, Co Chairman MP Materials (USA) – Co-chair
- Andreas Wendt, Chief Purchasing Officer BMW (Germany)
- Pierre Toulhoat, CEO BRGM (France)
- David Trafford, CEO CRU (UK)
- Franck Bekaert, Senior Partner McKinsey (Belgium)

Scientific Keynote speech

- Prof. Hideo Ohno, President Tohoku University (Japan)

Materials Efficiency in Portable Energy Storage

- Thierry Le Henaff, CEO Arkema (France) – Co-chair
- Shigeru Oi, CEO JX Nippon Mining & Metals (Japan) – Co-chair
- An Steegen, CTO Umicore (Belgium)
- Gilles Normand, Senior VP Electric Vehicles Renault (France)
- Michael Baier, Senior Vice President Battery Materials BASF (Germany)
- Peter Frischmann, CEO Sepion (USA) – WMF Award Coup de Cœur 2017

Societal Keynote speech

- Daniel Calleja Crespo, DG Environment EEC (EEC)

Debate : Plastics Recycling in Big Cities

- Tri Rismaharini, Mayor of Surabaya (Indonesia)
- Jean Hornain, CEO Citeo (France)

Breakthrough in Buy to Use for Aeronautics

- Jean Marc Chéry, CEO ST Micro (France/Italy) – Chair
- Klaus Richter, Chief Procurement Officer Airbus (France/Germany)
- Ghislain Lescuyer, CEO Saft (France)
- Kevin Kramer, Chief Commercial & Marketing Officer ATI (USA)
- Prof. Bronwyn Fox, Director of the Manufacturing Futures Research Institute University of Swinburne (Australia)
- Richard Wang, CEO Cuberg (USA) – WMF Grand Prix 2018

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INTRODUCTION

This was the 5th edition of World Materials Forum that we created in 2014. Always at the forefront of innovation, value creation and sustainable development. Always with key people from the entire world bringing their knowledge, time and talent to make a better world while using our materials "Smarter, Less and Longer". And this year with a focus on "making it happen", delivering more and faster thanks to enhanced collective intelligence. We have spoken with facts and figures during our "signature" sessions on Assessing Materials Criticality and Measuring Materials Efficiency. And we reviewed breakthrough technologies and business solutions for Water consumption, Recycling of electronic wastes, Portable energy storage, Autonomous vehicles and Future aircrafts.

So we would like to highlight our key achievements this year:

- the confirmation that our Criticality Assessment jointly developed by BRGM, CRU, Mc Kinsey and WMF is now used as a reference for key investment decisions in the field of critical materials
- the launch of our App «World Materials Connect» that offers a direct link between the CEOs of 13 Top Multinational Corporations and the CEOs of 90 breakthrough Start Ups all around the world
- the realistic goals announced by our speakers in our various plenary sessions:
  1. to reduce worldwide water loss by 2/3 and associated energy costs by 50% by 2030
  2. to divide by 2 the time to 80% charge of new EV batteries by 2030 (from 30 to 15 mns)
  3. to increase by 40% energy density of new batteries at cell level (from 700 Wh/L to 1000 Wh/L)
  4. to collect and recycle or reuse 80% of used EV batteries and 80% of used ICTs by 2035

OPENING DEBATE: SMART MATERIALS FOR WATER MANAGEMENT

A. PROBLEM STATEMENT

- There is a water crisis happening right now. Climate change and increasing urbanization mean that many countries and communities are suffering from severe water stress while, concurrently, other areas have too much water caused by extreme rainfall events leading to flooding and overcoming sewer and water treatment infrastructure.
- Current water infrastructure is, in many countries, inadequate. Water loss is excessive (~30% in developed countries; >50% in developing countries). Clean water and adequate sanitation is lacking in many developing countries and water is increasingly becoming unaffordable.
- As the world population heads towards eight billion, the cost of building or replacing infrastructure to handle current and future needs using conventional strategies is unsustainable. Smarter materials and methods are needed in order to solve this dilemma.

B. CURRENT STATUS OF EVOLUTION OF SMART MATERIALS AND STRATEGIES

- Smart strategies are currently being deployed by major players in the water sector to address water loss reduction and improve water network management. This includes the deployment of sensor networks to detect real-time leakage or mains failure so that early action can minimize water loss.
- The development of advanced monitoring and condition assessment technologies, combined with artificial intelligence and predictive analytics, means that unnecessary infrastructure replacement can be avoided and resources can be efficiently deployed to where they are most needed. Several case studies demonstrate the viability and success of these strategies.
- The development of advanced membrane technologies is leading to water treatment with significant energy savings and lower cost.
- Private capital is available for innovators to develop new materials and solutions and there are existing examples of how to accelerate the evolution of ideas from academic research to commercial deployment.

C. WHAT ARE THE FUTURE PROSPECTS FOR SOLVING THE WATER CRISIS FOR COMMUNITIES AND INDUSTRY?

- The greatest step change will likely come from major advances in water treatment technologies which will reduce the cost and energy consumption and improve the quality of water and sanitation for poor countries. Decentralization and commoditization of water treatment was proposed as a strategy for addressing the needs of urban and rural populations in developing countries.
- Continuing evolution of innovation in all aspects of the water cycle can be expected, leading to improved efficiencies and quality.
- Collaboration between and within industry, the public sector and capital markets will be needed to adequately address current and future needs.
- Enlightened public policy and regulatory frameworks that address all stakeholders priorities are necessary to achieve success.

CONCLUSION

The panel agrees that we can reduce worldwide water loss by 2/3 and energy costs by 50% by 2030 with increasing contribution from renewable energy if smart materials and strategies are widely deployed.

PS1: CRITICAL MATERIALS

- Overall improvement of our Criticality Assessment (12 elements of the Mendeleev table get better scores and only 4 worse - and none of the 4 becomes red)
- Focus should remain on the elements that remain Red though with some improvement: Cobalt, Tungsten and 3 Rare Earth (Neodymium, Praseodymium and Dysprosium)

A. NEW CAPACITIES ARE CRUCIALLY NEEDED WITH ECOLOGICAL DESIGN AND BASED IN COUNTRIES WITH LOW GEOPOLITICAL RISK (AUSTRALIA OR NORTH AMERICA)

1. Sunrise project in Australia (expected starting date in 2021 + new volumes nickel: 20kt (/120kt world consumption for battery usage in 2018) + 5kt cobalt (/120kt world consumption in 2018)
2. Mountain Pass project in California (expected starting date: 2020 + new volumes 5.400t NdPr(/50kt world consumption in 2018)

B. COOPERATION BETWEEN ALL ACTORS ALONG THE SUPPLY CHAIN IS A MUST TO AVOID SHORT TERM REACTIONS ADVERSARY TO LONG TERM TRENDS

1. Direct investment in mines that are no open pits but close to direct customers such as Apollo in the Pyreneans (expected delay: 5 years from public authorization + new volumes 1Kt tungsten vs 80kt world consumption and 3,5kt French consumption in 2018)
2. Also long term supply contracts between miners and car makers are on the agenda

C. SUBSTITUTION IS PROGRESSING

1. BMW announced new electrical engines that require no Rare Earth
2. The BASF - DOE project to develop cathodes with lower cobalt and higher energy density with same stability properties

D. END OF LIFE RECYCLING OF EE EQUIPMENT IS STILL IN EARLY STAGE BUT THE POTENTIAL IS IMPORTANT

1. BMW, Northvolt and Umicore project to recycle EV batteries and recover cobalt and rare earth
2. JX NMM LIB Recycle Testing Plan in Japan with recovery of cobalt and nickel

E. INTERNATIONAL COOPERATION IS REQUIRED AT EVERY LEVEL TO LIMIT IMPACT OF POLITICAL TENSIONS

1. Personal involvement of each key industrial actor
2. Use of existing international organizations to anticipate and smooth down possible conflicts (ICC, World Bank, European Development Bank)

FOCUS GROUP: MATERIALS EFFICIENCY OF THE ELECTRONICS SUPPLY CHAIN

A. KEY SECTOR TRENDS

1. Due to electronics market penetration, product innovation and reduced product lifespan, the amount of E – Waste (Waste from electronic devices) is the fastest growing waste stream in the world: the 45 Million tonnes in 2016 valued at €55 bn is estimated to reach 52,2 Million tons by 2021.
2. Appropriate waste management is crucial not only because it mitigates environmental impacts but also because it provides savings of critical materials - WEE scrap metal content can be higher than ore - and because it reduces price volatility of these same critical materials.
3. Revenues of waste recycling are moderate due to the (still) low recycling rate of electronic wastes (still in the 2 to 3% globally) and to the (now) reducing content in expensive metals (be gold, silver.. or cobalt and rare earths)
4. Costs of waste recycling are high due to (still) inefficient collecting schemes and (now) stricter and ever changing environmental compliance regulations.
5. Scrap processing is not always seen as an opportunity by public authorities (China or even Malaysia) « even if the integration of the informal sector has proven to be very effective through higher collection rates also for the formal recyclers (India or Ghana) »

B. MATERIALS EFFICIENCY SOLUTIONS AND GOALS

1. «Practical solutions » for the roadmap towards « Smarter, Less and Longer» have emerged from the discussion:
   Smarter:
   - Huawei higher energy efficiency (question for Shi what was the initial performance and what is it now?)
   - Huawei using bio based materials for green packaging
   - Regionalization of supply chains to make them cost and energy effective.

   Less:
   - reduced usage of critical materials thanks to recycling of e waste (example of Wisetek recycling 314,730 servers and recovering 78T of metals of which 71T of steel, 5,2T of aluminium and 1,5T of copper).
   - on going research at Apple, Samsung and Huawei to design new smartphone and make them both thinner and easier to disassemble with a limited number of raw materials used
   - Reuse of refurbished parts for manufacturing of new products.

2. Goals of Materials Efficiency shared by Focus Group speakers
   - Less and Longer in 2035 (used ICT): collect and recycle or reuse 80% of used ICT as soon as stakeholders (International organizations such as EEC, Big Cities, OEMs..) are creating framework conditions allowing a sustainable recycling industry to grow - see EEC funded project SRI in Africa or Chinese strategy to increase copper content of imported electronic and electric wastes.
   - Not only Materials Efficiency but also Materials Efficient Decarbonisation Pathways - question for Harry: can we mention your conference in Berlin on November 4th and 5th as a natural follow up to this session?»

PS2: MEASURING OUR PROGRESS ON USING MATERIALS SMARTER, LESS AND LONGER

Material efficiency and its link with sustainability has become a clear mainstream topic since last year. It was already in mind of each decision-makers – companies and regulators – it is now becoming a must for the final consumers. Monitoring, reporting, improving the material efficiency is not a nice-to-have anymore... it is now a must-have. The work that the WMF has done since 2016 on KPIs (key performance indicators) is essential. Looking back, the WMF has identified 9 cross-industries material efficiency KPIs and has tested them on different industries from Automotive to Smartphones, including Aeronautical or even Coil for heating system. For this session, the WMF experienced the KPIs through a value chain approach and proved the KPIs value for investors and for companies.

During the WMF 2019 work on the KPIs the following main observations were made:

- The KPIs are practical and concrete and straight forward to communicate in all industries
- Sustainable and Responsible investing is booming and creating value... and material efficiency KPIs can bring value to investors by being the relevant tools to support them in consistently allocating their funds
- All industry sectors have a positive momentum for emissions. If material efficiency is included as a core sustainability metric, significant value will be attributed to the winners ,and investment will accrue to the best players. e.g. "people who implement ME are more profitable"
- A study from the steel industry demonstrate that the KPI approach "Use less, longer, smarter" provide solution to four megatrends 1) Mega cities, 2) Digitalization, 3) Global Climate Action and 4) Industry 4.0 and reducing CO 2 will remain a major KPI in steel industry.
- KPIs approach is very compliant with Real Estate concerns and processes. KPI approach study also shows how the "user" of buildings leverages the KPIs approach and why it can generate value
- There is still work to be done to educate financial industry and regulators about the benefits with ME

As a conclusion, we believe it is urgent to implement our KPIs approach, because pressure is raising from everywhere. KPIs could be selected in a pragmatic manner by each industry, and an aggregate of the KPIs could become a relevant standard – probably industry-specific – to be used by all stakeholders: companies, customers and investors. Measuring material efficiency is a game changing opportunity for industries.

PS3: MATERIALS EFFICIENCY FOR PORTABLE ENERGY STORAGE

A: KEY SECTOR TRENDS

1. One Portable Energy Storage Technology has emerged : Lithium Ion , as of now in Liquid State, and Solid State as of 2025

2. The initial Portable Energy Storage Market of the smartphones is now mature and all growth will come from EVs.

3. This a complex topic both inside the cell, with 4 key components that interact with each other in order to ensure efficiency and safety at cost, and outside the cell with the challenges of access to critical materials and recycling

4. Market growth supports incredible technology evolution:
- lower cobalt content for cathodes
- move from graphite to silicium or lithium for anodes
- more efficient separators thanks to coatings
- new electrolyte salts
- .... and ultimately solid state.

5. What still needs to be understood, estimated and measured:
- the pace of adoption of new technologies (whether cathodes, anodes, separators or electrolytes)
- the key drivers (necessary regulations?) towards recycling or reuse at the end of life
- the impact of all these trends on using critical materials smarter, less and longer.

B: MATERIALS EFFICIENCY SOLUTIONS & GOALS

1. «Practical solutions» for the roadmap towards « Smarter, Less and Longer» have emerged from the discussion:

Smarter:
- higher usage rate of cars (Renault example of Zoe shared system in Madrid)
- improved battery performance to weight (Renault cooperation with Enevate)
- regionalization of supply chains (JX and Umicore)

Less:
- reduced usage of critical materials (BASF example of high nickel cathode with reduced cobalt, Arkema example of cathode production by extrusion)
- new and thinner design of battery components (Sepion)
- recycling the metals along the battery life (Umicore and JX)

Longer:
- Number of Cycles (Arkema additives and electrolytes for long cycling)
- Range (Arkema and Sepion)
- Second life: reuse of batteries whether for same or different usage (all)

2. Goals of Materials Efficiency shared by co-chairs and speakers
- Smarter in 2030 (new batteries) : 80% charge in 15 minutes - currently 80% in roughly 30 minutes
- Smarter and Less in 2035 (new batteries) : Energy density at cell level of >1000 Wh/L or >350 Wh/kg specific energy - currently 700 Wh/L and 250 Wh/kg are best-in-class
- Less and Longer in 2035 (used batteries): collect and recycle or reuse 80% of used EV batteries - currently 5%

SOCIETAL KEYNOTE SPEECH

Environmental protection is a priority for 95% of European citizens. The Circular Economy is both a solution for environmental protection and an opportunity to create Jobs, Growth and Investment in Industry.

At EU level, this has already meant since 2016:
- 650 M€ contribution to H2020 R&D projects for Circular Economy
- 2.400 M€ EIB credits to Circular Economy projects.
- 10 one to one green green business partnership events abroad (with Chile, China, South Africa, Colombia, India, Japan, Indonesia, Mexico, Singapore, Malaysia)

The example of plastics is powerful with a combination of goal setting, private actions, public support and international cooperation. By 2030:
- All plastics packaging will be reusable or recyclable
- > 50% of plastic waste will be recycled
- Sorting & recycling capacity will be X 4 (vs. 2015).

Beyond plastics, EU companies by embracing the circular economy strategy, can be the big winners saving 600 billion euros per year, reducing emissions up to 4% and creating the jobs of the future. EU standards can become global standards.

DEBATE ON PLASTIC RECYCLING IN BIG CITIES

Plastic recycling is a challenge for both Surabaya and France but they tackle it in a different manner:
- France focuses on recycling rate with the objective to have plastic recycling rate (26% in 2018) to reach the same level as other materials (70% for household packaging altogether)
- Surabaya focuses on reducing landfill disposal while the population strongly increases: the nb of tons per day in landfill has decreased by 4% over the 2014-2018 period while the city population increased by 20%.

In terms of solutions, France focuses on developing recycling technologies, promoting deposit systems and increasing cities sorting equipment while Surabaya focuses in massive engagement of citizens through multiple channels (beach cleaning contest, zero waste at school campaign, promotion of metal straws, municipal waste power plant, fashion shows using recycled materials).
Both speakers agreed that they were complementary approaches and that cross fertilization would be a big plus.

PS4: MATERIALS EFFICIENCY THANKS TO AUTONOMOUS VEHICLES

KEY SECTOR TRENDS

1. Automated vehicle with an electric powertrain is going to answer several mega trends, societal trends, automotive trends and consumer expectations.

2. Making autonomous vehicles happen in mass production on the market is going to be a 2 phases process
   - First, a maturation learning phase. It started from 2010/2015 and should go on until 2025/2030. The main stakes and challenges for a non-predictable market are
     - Define and converge regarding regulations :driverless, road infrastructures, city policies and need for vehicle supervision.
     - Technical definition (mainly set of sensors for the different autonomy levels and electronic architecture) and economics to make it affordable.The high projected costs of level 4 and 5 should only lead to professional applications.
     - Large scale tests led currently by Waymo with 10 million miles.
     - Investments : more than 800GWh battery production capacity needs representing around €100bn investments by 2030 and €40bn for charging points.
   - Then an efficiency phase, starting in 2025/2030, producing its full effects from 2040-2045 and going on after that. Combining autonomous vehicles and electrification will lead to
     - Improve the environment and mobility conditions: declining in CO2 and pollution emissions, better health, 5 to 10 times less fatalities, robocab travel cost decrease by 70%, better access to mobility for disabled or elder people
     - Optimize material usage: 15% less energy consumption thanks to road traffic management, car manufacturing drop by 2040 due to higher mobility sharing, 200kg average weight saving thanks to accident avoidance, life time increase and less maintenance costs thanks to electric motors.

MATERIALS EFFICIENCY SOLUTIONS AND GOALS

1. Smarter: Huge potential material saving due to a higher utilization rate of the vehicle and mobility sharing, better traffic management and collision avoidances.
2. Longer: better traffic management and collision avoidances as well as new vehicle concepts and business models allowing reshuffling, functional design, predictive maintenance, Over The Air and hardware upgrades will all contribute to extend the vehicle life cycle. Shared mobility will also put the emphasis on the need of self healing, self cleaning materials such as graphene technology (x16 life time vs epoxy/glass)
3. Less: Reduce the weight of vehicles thanks to materials like composites : carbon fiber structures reducing weight by 35% versus aluminum or new designs like structural batteries could lead to 50% weight saving versus current design or additive manufacturing. 4D printing, changing the shape of the part from a material stimuli could open. Without forgetting Additive manufacturing as a potential game changer.

And reduce the quantity of materials used altogether thanks to simulation: Numerical models used to simulate autonomous driving have a huge impact (1 month simulation is equivalent to 236 years of road test) and automatic topology design incorporating new materials can lead to 20% weight saving

But caution:

- Such a transformation will require a massive increase of computing power for autonomous vehicles; 100 million lines of code will be necessary (x15 versus a Boeing 737).
- A key factor will be the affordability of new materials, particularly to get to level 3 autonomous driving (eyes off/hands off) high speed from level 2 will require to multiply by 25 the material costs.
- Another one will be Recyclability as current consumer vehicles may be 90% recycled. Driverless electric vehicle are mainly made of composites which allows a 55% recyclability average rate. The goal will be to reach 90% recyclability and more thanks to the use of new technologies such as vitrimer composites (Malinda)
- The priority - and difficulty - will be to work as an ecosystem across industries and all along the entire life cycle from creation, through design, use, reuse, in-cycle improvement and finally repurposing or return to the original material will be planned and monetized and monitored.

PS5: BREAKTHROUGH IN BUY TO USE FOR AERONAUTICS

KEY SECTOR TRENDS AND CHALLENGES

Air transport is steadily growing at a pace of 5 to 7% per year with direct impacts on the environment

- According to the International Civil Aviation Organization, passenger air traffic has almost tripled to 4 bn passengers in 2017 in just 20 years. Freight air traffic has doubled in the same period.
- In Europe, if air traffic has increased by 60% since 2005, average fuel consumption of commercial flights has been decreased by 24% and average noise is down by 14%. However, full flight emissions have increased by 16% in CO2 and 25% in NOx. They are predicted to further increase by 21% and 16% respectively by 2040 (source = European Aviation Environmental Report 2019)
- While traffic increases linked to population and wealth growth, there is increased societal scrutiny from the public and governments, leading to tighter regulations and standards.

Players in the aerospace industry remain challenged to solve the difficult equation of lowering environmental impacts, optimizing performance and safety while ensuring competitive aircrafts.

- Critical performance drivers in the context of the WMF classification (smarter, less and longer) are structural weight & fuel consumption (smarter), buy to fly ratio (less), Cutting tool consumption and maintenance (longer).
- New technologies are being investigated at different levels, including printed electrics, Li-Ion, Additive Layer Manufacturing, E2E material management, hybrid cutting tools, ceramics, alternative fuels, LED and composites.

MATERIALS EFFICIENCY SOLUTIONS AND GOALS

Battery storage, safety and performance altogether are even more critical in the aircraft than they are in a car. Which means improved charge density, lighter weight, more compact, corrosion resistant components, novel battery chemistries and processing, surface chemistry and morphology. For example the number of cycles for the duration of the battery is far more demanding : 3500 charging cycles in a year vs 1500 cyles in 10 years for a car battery.

- Saft is developing a solid state battery for better performance, lower cost and intrinsic safety. New technologies based on lithium foil increase the specific energy and power from 372 mAh/gram for carbon to 3800 mAh/gram.
- Cuberg proposes a lithium metal battery that enables 70% longer flight time while providing better safety.

And Materials fully contribute to meet the challenge:

- In the wider framework of additive manufacturing, the Swinburne university of technology proposes a new testlab for fill multilayer process which reduces carbon fibre waste from 60% to 10%. It also develops graphene enabled smart structural composites for various types of sensing (strain, damage, temperature, thermoelectricity or flow).
- The usage of advance materials from ATI like Nickel Superalloy Powder and Isothermal forging enable 15% improvement in fuel efficiency and CO2 emissions and a 75% reduction in noise. Digital metals also enable smarter manufacturing with tailored microstructure, reduced part count and cycle time reduction.
- Finally Silicon Carbide is a key enabler while bringing higher conductivity. When ST Microelectronics uses it in PMOSFETs, energy commutation is 10 times faster and energy losses are reduced by 90%. »

START UP CHALLENGE AWARDS AND NOMINEES

THE 3 AWARDS

Following the jury meeting on April 5th and the nomination of 18 Start Ups on April 15th, the Grand Prix and the other 2 Awards were finally announced during the Gala Dinner on June 13th. Prof. Victoire de Margerie, Jury Chairman states : «The 3 Awards went legitimately to 3 start ups that fitted the best with the WMF objective of decoupling materials consumption from sustainable growth while creating value for all involved stakeholders. Or in other words to these that could best demonstrate their impact in Using Materials Smarter, Less & Longer».

GRAND PRIX

The « GRAND PRIX » (50,000 € in cash as well as a custom market survey to be realized by Special Chem) was awarded to Jelena Stojadinovic, CEO of MEMBRASENZ (Germany), by Prof. Victoire de Margerie, Jury Chairman and Prof. Stéphane Mangin, Jury Vice Chairman. MEMBRASENZ (Bochum, Germany) : Gas-separating membranes to be used in alkaline electrolysers (in order to split water into H2 and oxygen) while achieving excellent gas barrier properties and with 50% higher ionic conductivity compared to state of the art Zirfon membranes.

SPECIAL AWARD CRITICAL MATERIALS

The « SPECIAL AWARD CRITICAL MATERIALS » (20,000 € in cash as well as a custom market survey to be realized by Special Chem) was given to Preston Bryan, CEO of MOMENTUM TECHNOLOGiES (USA) by Reinhold Dauskardt and Matt Price, members of the Jury. MOMENTUM TECHNOLOGIES (Dallas, USA) : MSX membrane Technology (reverse osmosis) that extracts high purity rare earth oxides from a wide range of magnetic waste feedstock (MRIs, cell phones, electric motors) without requesting the use of high temperatures or pressures.

COUP DE CŒUR AWARD

The « COUP DE CŒUR AWARD » (20,000 € in cash as well as a custom market survey to be realized by Special Chem) was awarded to Marescotti Ruspoli, CEO of AERONAUTICAL SERVICES (Italy) by Bernard Pinatel and Edith Coune, members of the jury. AERONAUTICAL SERVICES (Roma, Italy) : Customized nano structured materials for extreme tasks and related mathematical models to predict the performance of such materials noticeably in the field of high temperature shielding & fireproof, electro magnetic waves absorbing & shielding and Sound Absorbing.

The jury

- Christophe Cabarry, CEO Special Chem (France)
- Edith Coune, COO Innovation Fund (Belgium)
- Prof. Reinhold Dauskardt, Stanford University (USA)
- Joe De Simone, CEO & Co Founder Carbon 3D (USA)
- Gervais Jacques, COO Rio Tinto Aluminium (Canada)
- Prof. Stéphane Mangin, Institut Jean Lamour (France)
- Prof. Victoire de Margerie, Vice Chairman World Materials Forum (France) - Chairman
- Tony O'Neill, Group Technical Director Anglo American (UK/Australia)
- Bernard Pinatel, President Refining and Chemicals Total (France)
- Matt Price, MD Cyclotron Road Berkeley (USA)
- Sophie Zurquiyah, CEO CGG (France)

THE OTHER 15 NOMINEES

ALIGNED CARBON (San Jose, California) / John Provine
Carbon Nano Tubes that would support further transistor scaling (so called Moore Law) thanks to their integration into the semiconductor manufacturing process (in combination with FinFet).

ASTRILEUX (Berkeley, California) / Supriya Jaiswal
Advanced materials for EUV Lithography to manufacture ICs at 7 nm and smaller.

DEMETA (Rennes, France) / Patrick Piot
New class of polymer manufactured from a underutilized by-product of the petroleum industry (dicyclopentadiene), with a simpler production process, lower carbon and energy footprint and superior performances (toughness, lightness) than existing materials (epoxy, polyester, vinylester or PU).

FLUENCE ANALYTICS (New Orléans, USA) / Alex Reed
Big Data to monitor real time polymer reaction and achieve optimum reaction efficiency/product quality thanks to adjusting process variables such as temperature, pressure, reagent feed rates, and reaction time.

FREDSENSE (Calgary, Canada) / David Lloyd
Innovative, faster and more sensitive (1ppb) electro chemical sensors for detecting very low concentrations of Arsenic and other contaminants in industrial water such as for gold mine effluent treatment.

FULL MOON (Stanford, California) / Ehsan Sadeghipour
First low power and low cost sensor capable of quantifying and differentiating between various molecules with 1st used case in detecting leaks of natural gas with the same performance as existing expensive IR spectroscopic sensors.

HYMAG'IN (Grenoble, France) / Camille Crouzet
Hydrothermal oxidation of ferrous wastes into high performance magnétites for water treatment.

KEBOTIX (Cambridge, USA) / Jill Becker
Combining data and AI with robotics to discover and create advanced chemicals and materials at a faster rate and at the push of a button.

MATERIALSZONE (Israel) / Assaf Anderson
Research platform for Scientific Data and AI modeling with the aim to accelerate the advent of new technologies thanks to harvesting, interpreting, and exchanging materials science related data.

MOSAIC MATERIALS (Emeryville, California) / Tom Mc Donald
Separation technology that reduces the capital and operating expenses of carbon capture from nearly any mixture, including large point sources, natural gas, biogas, and ambient air.

NAWA (Le Rousset, France) / Ulrik Grape
Electrode material that combines nano/clean technologies for a Carbon Battery that stores more electricity, more rapidly - telephones, cars, renewable energies, buildings.

OPUS 12 (Berkeley, California) / Nicholas Flanders
Technology that bolts onto any source of CO2 emissions and with only water and electricity as inputs transforms it into chemical products such as ethylene & methane.

RAMLAB (Rotterdam, NL) / Vincent Wegener
Wire Arc Additive Manufacturing (WAAM) that makes additive manufacturing of large parts feasible at acceptable cost, speed and quality.

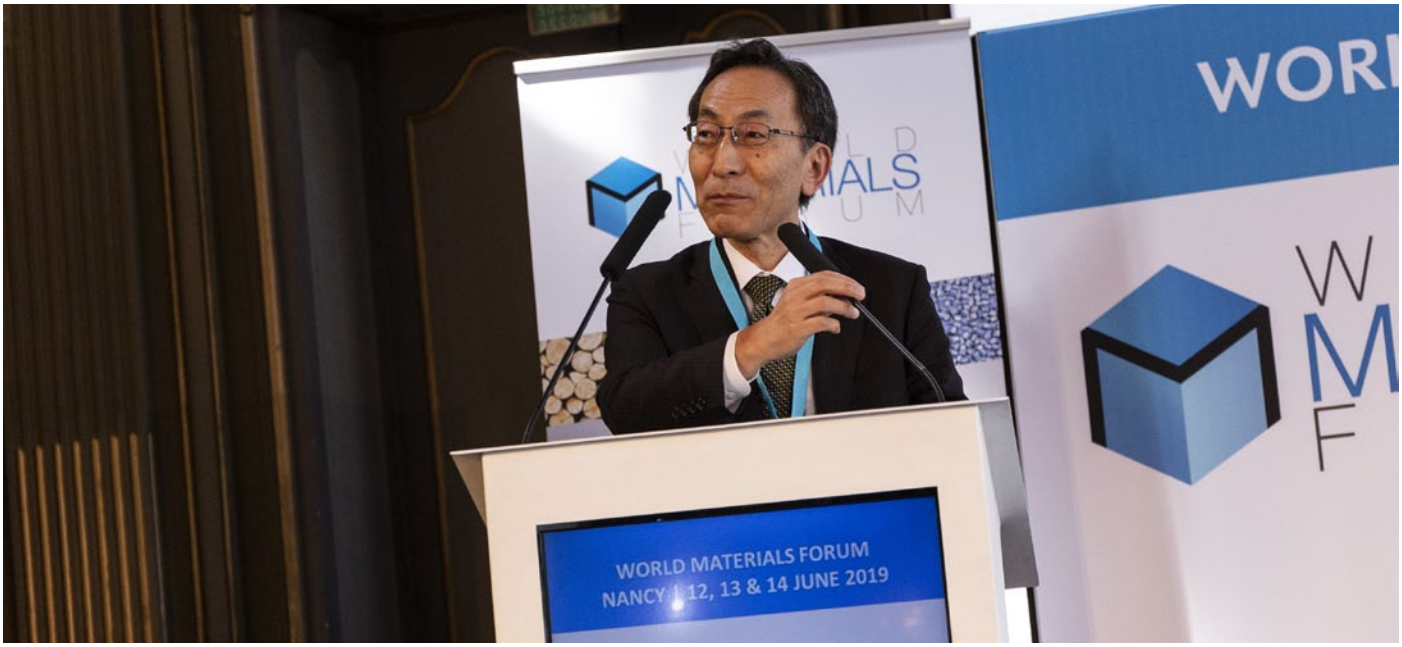
SAFI Organics (Kenya) / Samuel Rigu
Novel chemical process in order to break down cellulosic chains 100 times faster than traditional composting without any external energy or heat and locally produce a substrate sufficiently organically rich to support microbial growth and retain nutrients moisture in the soil effectively.

TRIMATERIALS (Brescia, Italy) / Stefano Sacrato
Paints that prevent buildings from collapsing in an earthquake.

SCIENTIFIC KEYNOTE SPEECH

The development of Internet of Things (IOT) and Artifical Intelligence (AI) produces an ever increasing amount of Data that needs to be processed and stored. This leads to huge energy consumption: interconnected devices are expected to contribute to 20% of the world electricity consumption in 2025... and this is not sustainable!

We need to move toward ultra-low energy consumption for electronic for computing, data storage and sensors. Spintronic (Spin Electronic) can be the solution. Based on interface properties at the atomic scale this technology uses the electron spin to carry information and therefore reduces the energy dissipation due to joule heating. For instance researchers at Tohoku University have demonstrated a decrease of 97% to 99% of power consumption for several types of processors and memories. Moreover they have shown that thanks to the use of interface, less material can be used throughout the process.



CONCLUSION

We hope that you enjoyed reading these Key Take Aways as much as we enjoyed drafting them after so many inspiring sessions and debates and these realistic goals announced by our speakers.

Our 6th edition will happen **on June 10th and 11th 2020** and the general theme will be **From Breakthrough Innovation to Industry: Sound and Fast**