ISSN 2056-6735 (Online)

The Crucible

Review of MMTA's Dublin Conference 2017

Automotive battery growth enters ludicrous mode

Non-ferrous industry vision 2050

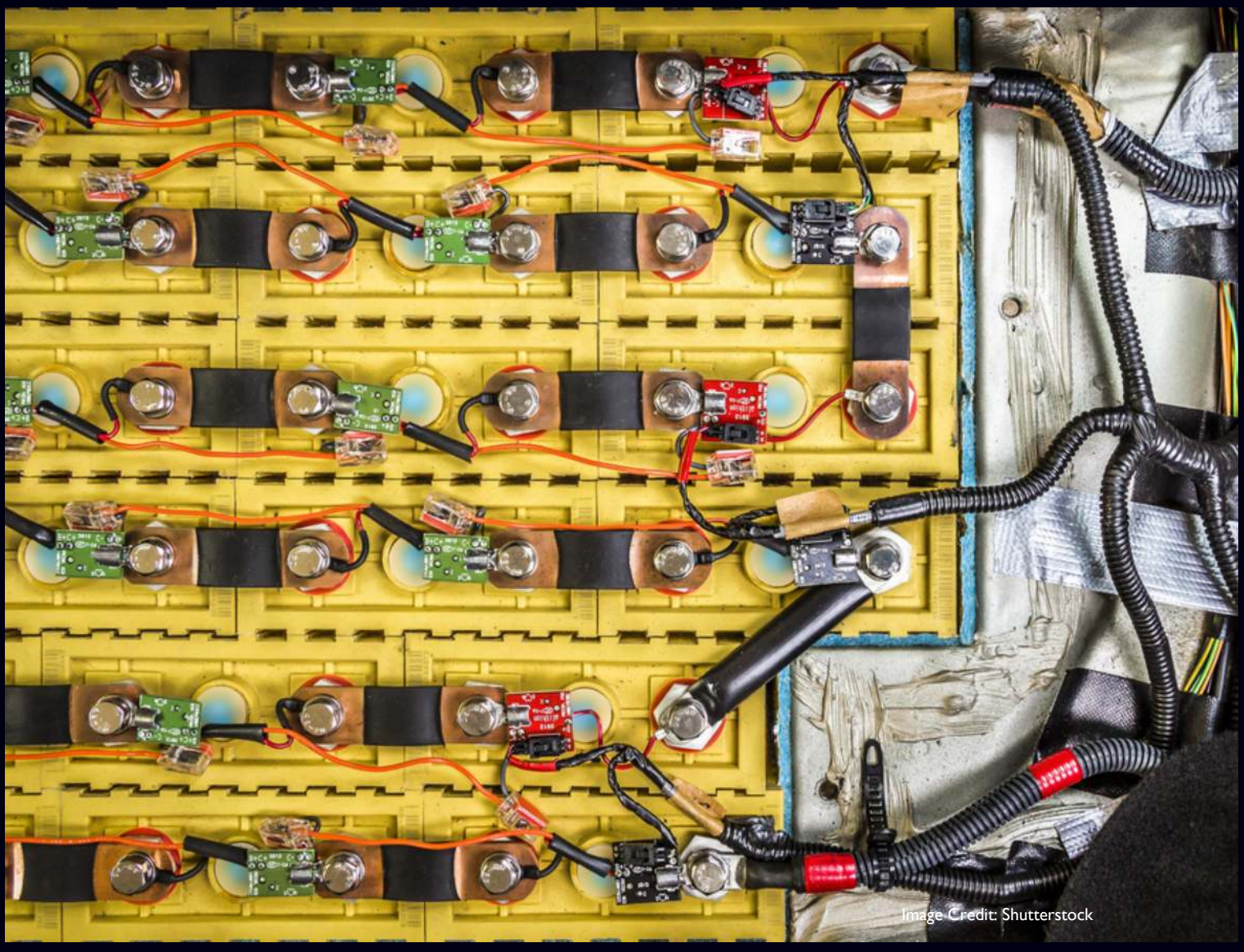

Image Credit: Shutterstock

The magazine of the Minor Metals Trade Association

5th Edition 2017/May www.mmta.co.uk

Credit Insurance Challenges in a Rising Market

Image Source: Shutterstock

The MMTA was interested to understand the approaches of leading underwriters in the credit insurance market: how they assess risk, and what their strategies are to support those involved in the minor metals industry during this period of change. Many will remember a period during and following the crash when many lines of credit were pulled, some with little notice and, along with new MMTA member, Marsh Ltd, we went to meet with representatives from three underwriters: Euler Hermes, Atradius, and QBE. We were interested to learn whether they are interested in small markets, where cover needs to be flexible enough to support long-term deals.

It would be difficult to disagree that 2016 was characterised by a series of unexpected events, including the Chinese stock market crash in January, huge drops in oil prices in Q1, the Brexit vote, struggles in emerging markets and in November, the US election outcome.

The common theme from all the underwriters was the need for transparency, especially in small markets like minor metals. Although their models are built on proximity to risk through local knowledge and expertise, they rely on conversations with clients to help them build an informed picture. This means that ongoing and open conversations between client and insurer are key. Underwriters did experience increased exposure in the metals sector during 2016, which was a hangover from 2015, when lots of risk reviews were undertaken, but they were keen to stress that lessons had been learnt from the way they reacted during the crash of 2008.

"Insolvencies are set to increase in 2017 in 6 our of 10 countries worldwide, and remain above the pre-crisis level in more than half of the countries studied." (Euler Hermes)

There are certain markets, including some Middle Eastern countries, where financial information available can be patchy, and payment delays lead to a more cautious approach. Some African markets are characterised by high levels of particularly short-term debt, and even in some parts of Europe, unemployment and a fragile banking sector are key factors affecting cover. In Asia, China and Singapore, in particular, continue to experience rising levels of insolvencies, with smaller increases in other markets. The impact of Chinese ownership of overseas assets will be monitored over the coming years, particularly in stressed conditions. Despite the fiscal boost, a small increase in insolvencies is anticipated in the USA, and also in Canada, due in part to weak exports. Brazil, in contrast continues to suffer from a hard recession, and consequently double digit insolvencies are expected.

With many markets currently growing, and prices increasing even where volumes remain the same, a key question to underwriters was whether limits can be increased, whether across the board or on a more targeted basis. The insurance industry recognises its importance to the sector, and crucially that the cycles are different from the majors, resulting in different approaches to coverage. As an industry, it has many more tools at its disposal than previously.

With the return of volatility to the markets, there is the chance to make money again. After several years of low inventory levels, stocks are beginning to be built up again, and forward purchases are being made. There are more flexible policy options for credit insurance, including hybrids between whole turnover and single risk, in order to cover all needs, wherever possible. During the meeting, we were able to convey the importance to clients of limits that may remain unused, depending on whether business is won or not, in which case the limit will fall away, so these 'prospect limits' should not be seen as true exposure until such time as they become live when business is won.

To make good decisions, typical information required by underwriters outside of accounts include details of key suppliers and customers. Given the level of volatility and end-user demand, an understanding of contracts currently in place, order book details any committed forward orders and price is key. To understand the company's financial flexibility and scope for growth, and capacity to deal with external shocks, full funding details are important. It is also important for the underwriter to have an understanding of the cashflow cycle, and identify any pinch-points, as well as credit lines currently in place from banks. Our thanks go out to Marsh Ltd, Euler Hermes, Atradius, QBE, Wogen Resources and AMC for their participation.

In Brief

New elements named

The recently discovered 118 element in the Periodic Table has been named after Yuri Oganessian who leads the Flerov Laboratory of Nuclear Reactions at the Joint Institute of Nuclear Research in Dubna, Russia. He is the only living person to have an element named after him. The super-heavy atom is named **Oganesson** and has the symbol Og. The other three recently discovered elements are named as follows:

- **Nihonium** and symbol Nh, for the element 113
- **Moscovium** and symbol Mc, for the element 115
- **Tennessine** and symbol Ts, for the element 117

Waste silicon sawdust for lithium-ion battery anodes

Researchers have created a high performance anode material for lithium-ion batteries (LIBs) using waste silicon (Si) sawdust.

It is energy-consuming and expensive to produce Si wafers with high purity (> 99.99%). On top of that, some 50% of Si is actually discarded as industrial waste in the final cutting process. This waste is about 90 thousand tons a year worldwide, an amount large enough to meet the global demands for anode materials for LIBs.

To make this happen, under the project of "Dynamic Alliance for Open Innovation Bridging Human, Environment and Materials," a joint research team from Tohoku University and Osaka University has developed a practical and mass-producible method of recycling the unwanted Si sawdust into a high-performance anode material for LIBs.

The team found that the pulverization of the Si sawdust into Si nanoflakes (~16 nm in thickness) and the subsequent carbon coating are effective in fabricating high capacity and durable LIBs. So far, a test half-cell has achieved a constant capacity of 1200 mAh/g over 800 cycles. This capacity is 3.3 times as large as that of conventional graphite (ca. 360 mAh/g).

The proposed method of material recycling is applicable for the mass production of high-performance LIB anode materials at a reasonably low cost. The research team expects that it will have great practical use in the battery industry.

Production process from silicon sawdust to lithium battery anode.

Source: Tohoku University

http://www.tohoku.ac.jp/en/press/silicon_sawdust_recycled_for_lithium.html

Renewables Rising

According to UN Environment and several other sources, renewable power generation from wind, solar, biomass, geothermal, small-scale hydropower, marine energy and waste to energy rose by 8% in 2016 to 138.5 gigawatts from 2015.

INSIDE THIS ISSUE

The MMTA promotes essential elements that add quality, safety and enjoyment to our lives.

The MMTA is the world's leading minor metals industry organisation.

Contact Us:

Address: MMTA, Suite 53, 3 Whitehall Court, London, SW1A 2EL, UK

Tel: +44 (0)207 833 0237

Email: executive@mmta.co.uk

Power dense zinc-manganese power unit as cheap as a car battery

A team of scientists working on analysing energy flows in prototype zinc-manganese batteries have stumbled upon a new way to make these power cells much more reliable, with many more recharge cycles than the humble lead-acid car battery, but costing around the same to produce. The creators claim that the new battery could become an inexpensive, ecologically sound alternative for storing energy from renewable sources and a high-density solution for storing excess energy from the power grid.

Working at the Department of Energy's Pacific Northwest National Laboratory (PNNL), the researchers discovered a new way to approach the reliability problems of zinc-manganese batteries, that were cheap and easy to make from abundant materials, but which would fail after only a few charge cycles.

Years of study on lithium-ion (Li-ion) batteries and their electrical characteristics had blinkered many researchers into believing that the behaviour of lithium ions in those batteries would be replicated in the Zn-Mn cells. To store and release energy in Li-ion cells, a process known as Intercalation (where lithium ions moving in and out of microscopic spaces in between the atoms of the cell's two electrodes) occurs.

Much to the surprise of the PNNL team, however, a range of tests actually showed that the device being analysed was undergoing a completely different process. Where a Li-ion battery would move its ions around in the charging process, the Zn-Mn version was actually being subject to a (hitherto unknown) reversible chemical reaction that transformed the active materials in the electrodes into a completely different substance known as zinc hydroxyl sulphate.

Once the team realised that something different may be going on in the Zn-Mn unit they built, and that something may be that the Zn-Mn battery acted more like a lead-acid one, they decided to bring out the big guns in the form of X-ray diffraction, nuclear magnetic resonance imaging (MRI), and transmission electron microscopy.

What they found was a complete surprise to them all. Tests showed that the battery's manganese oxide positive anode was reversibly reacting with protons from the water-based electrolyte in which it was immersed, to create the new zinc hydroxyl sulphate material. As a result, the new material soon coated the electrode, and the power flow and cycle capabilities were reduced considerably.

Using their new-found knowledge, the team then went about finding ways to reduce (or even stop) this process. Realising that chemical conversions were the culprit, they simply figured out that the pace at which the manganese was being transformed could be reduced by upping the manganese concentration in the electrolyte before applying power. (Interestingly, this is not too dissimilar to the research on Lithium-air batteries that sees great improvements when their electrolyte mixes are altered to reduce electrode disintegration). And it worked. The researchers claim that the tiny test battery achieved a storage capacity of 285 mAh per gram of manganese oxide over an extraordinary 5,000 cycles, with 92 percent of its initial storage capacity retained.

The researchers plan to carry on their analysis of how the zinc-manganese oxide battery operates, in the hope of further increasing their knowledge of the reactions and to fiddle with the electrolyte concentrations to try and wring out as much efficiency as possible.

The results of this research were published in the journal Nature Energy.

Source: Pacific Northwest National Laboratory

Responsible Sourcing

What is Responsible Sourcing?

Looking beyond cost, quality and consistent supply of materials to incorporate conflict minerals, greenhouse gas emissions, human rights, corruption, and environmental impact, amongst other supply chain issues. Demonstrating to your customers that you reach certain standards in these areas.

What is the MMTA doing?

Consolidating and simplifying information on Responsible Sourcing to create a straightforward and easy-to-understand guide for MMTA Members, in particular SMEs.

How can you help?

Are you interested in helping us create a Responsible Sourcing Survey?

Does your company have a policy already? Would you be willing to share it with the MMTA? (tamara@mmta.co.uk)

What do you think about Responsible Sourcing?

What does industry say?

We expect our suppliers to support us in being trusted to deliver excellence and help them to do so through our Global Supplier Code of Conduct. We expect our suppliers to be ethical, responsible and to fully comply with all applicable laws and regulations. ***Rolls-Royce***

Products made to have a positive impact. On the world and the people who make them. ***Apple***

ADVANCED ALLOY

SERVICES LIMITED

We focus on quality

Established over 21 years with an unrivalled reputation for supplying pure metals and high temperature super alloys into the aerospace, oil, medical and associated industries

Accredited ISO 9001, ISO 14001, BS OHSAS 18001

We buy & sell

Specialists in the supply of

- Mo
- W
- Nb
- Ta
- Hf
- All Nickel / Cobalt based alloys

Full revert management/processing

- Shot blast
- Size reduction/plasma
- Bar cutting
- Turnings degreased

Suppliers of High Temp Raw Materials & Pure Metals

Call us on **01909 569930**
Email us at **info@advancedalloys.co.uk**
Website **www.advancedalloys.co.uk**

CCAS UKAS mmta Minor Metals Trade Association

Engines, batteries and Innovation: A review of the MMTA's Dublin Conference 2017

A record number of delegates joined the MMTA in Dublin for the International Minor Metals Conference last month. An outstanding programme of speakers and a warm, convivial atmosphere made the premier event of the minor metals calendar particularly impressive this year.

Laurence Knight and Andrea Sella performing their onstage experiments

Kicking off the day in the Keynote spot, Andrea Sella from UCL and Laurence Knight from BBC World guided the audience through "An amazing journey among the elements". Garnering audience participation and performing onstage experiments, the duo took a slightly different view of a selection of elements including **tantalum, vanadium and platinum**.

Continuing proceedings, the first session focused on developments in specialty metals, beginning with "Developments in aero-engines and material choice", by Bill Reid, Strategic Sourcing Manager of Pratt & Whitney. Bill spoke about the positive outlook on future aircraft orders and the materials required to support these orders, as well as materials selection for efficiency and durability in engines.

"Arconic's position in the minor metals world", by Ben Franck, Director, Commercial Metals Procurement at Arconic (the new name of the engineered products business of the former Alcoa) looked at global mega trends such as urbanisation, the rising middle class and energy efficiency, and their influence on Arconic's future business in aerospace and automotive.

Markus Moll (SMR) provided "an update on specialty and stainless markets", giving an engaging look at market trends. Markus predicts a price rise for molybdenum during 2017.

Bill Reid, Pratt & Whitney

Former MMTA Chairman, Guy Darby (Darton Commodities), gave a brief report on developments in Mufulira, the MMTA's chosen charity. Guy talked about the medical electives programme, the MMTA Member funded anaesthetic machine in the local hospital, future plans to help send more medical students to Zambia, and, hopefully, some Zambian medical students to undertake an elective in the UK.

The tantalum and supply chain session opened with a fascinating insight into INTEL's supply chain and the work they have done over the years to map and trace their material supplies and guarantee a 'conflict-free' microprocessor. Carolyn Duran, Director, Global Supply Management, talked about the efforts to ensure conflict free tantalum smelters and the challenges that we all face to broaden the scope of responsible supply to include new criteria such as child labour and environment, as well as to all materials and not just the 3Ts and gold.

Yuri Freeman, Director of Advanced Research, Kemet Electronics Corp, continued proceedings with a look at the development of tantalum capacitors, the key to a myriad of modern technologies and enabling the digital revolution.

The first day concluded with topical discussion groups on 'Rhenium, Hafnium, Zirconium', 'Supply Chain Issues',' and Battery Metals Outlook for Lithium and Cobalt'. These groups were attended by around 100 delegates, with discussions held between participants over a pint of Guinness or two!

The second day opened with the topical issue of 'Batteries and storage'. Andy Miller, from Benchmark Mineral Intelligence, kicked things off with "The Lithium ion battery mega factories: Lithium, graphite and cobalt impact". Andy believes that China will be the driver for raw materials to fuel the lithium ion expansion. Rebecca Gordon of CRU Consulting looked at sources of raw materials for batteries and

stressed that cobalt demand could not be met without supplies from the DRC.

"Outlook for antimony", by Geert Krekel, Managing Director of Campine, started the session on "Electronics metals: the future is bright". Geert looked at factors affecting the antimony market, such as technical performance, regulation and security of supply.

"Future applications for minor metals: Bi, In, Se, Ge & Ga", by Dominic Boyle of Fortis Metals, offered a high level overview of new applications for these metals, including developments in wrap-around TV screens, solar panels, 5G mobile networks and 2D materials. The session ended with "China's industry development and market demand for gallium, selenium and tellurium", by Feng Juncong, from the CNIA (Chinese non-ferrous industry association), who offered a view of future metals demand from a Chinese perspective.

Yuri Freeman showing a tantalum capacitor

Finishing up the programme, the speakers looked at new material opportunities. "Rhenium – the role of a transition metal in a precious metals world", by Michael Arndt, of Heraeus Deutschland GmbH, examined the rise of rhenium and its applications in super alloys, space, medical and the petrochemical industry. Michael also discussed the key criteria when managing rhenium supply and suppliers.

Oleg Anikin, Investment Director ICT Group of Companies & Board member of TriArk Mining LLC wrapped up the Conference with "Tomtor — an alternative source of supply for scandium and niobium". Oleg looked at TriArk's new mine in the North of Yakutia, Russia. This is a huge deposit and very rich; as of April 2017, an average ton of ore contained about 3,000 USD worth of niobium and REO (not accounting for Sc and other potential by-products). The mine is set to open in 2019, and the value of the ore makes the logistical and climate issues worth overcoming.

The MMTA would like to thank our excellent line-up of speakers, as well as the generous sponsors of the conference. We were delighted to welcome back returning delegates and meet many new ones. We look forward to welcoming you to Montreal, Canada next year.

Lithium supply reacts as automotive battery growth enters ludicrous mode

The market for lithium-ion (Li-ion) batteries was 92GWh in 2016, a ten-fold increase from the 9GWh used a decade earlier. Growth has been driven by an increase in the number of applications using them, as well as gains in market share versus other rechargeable battery types. From the 1990s through to the early 2010s, the market was predominantly in portable consumer electronics, with the transition from mobile phones to smartphones, and the introduction of tablets, increasing battery capacity per device despite lower unit sales growth as markets became saturated. More recently, growth has been accelerating as the automotive market has started to electrify its powertrains. Automotive uses absorbed almost 50% of Li-ion battery output in 2016, up from 27% in 2014 and 7% in 2012; a large jump in electric bus output in China in 2015 being the main driver.

Transport to dictate Li-ion battery market through to 2026

A strong government drive in many countries to increase penetration of hybrid, plug-in and full electric vehicles (xEVs) to meet emissions objectives is underpinning xEV development. Meanwhile falling battery costs, improved battery range and charging infrastructure build-out is reducing vehicle costs and boosting consumer interest. Tesla has made EVs the iPhone of the automotive world, if not driving the market by volume then certainly in appeal. Roskill expects the positive trend in xEV sales to increase and full electric vehicles to compete on price with current gasoline/diesel models in the early 2020s without incentives; the transportation market for Li-ion batteries in our baseline forecast could therefore reach 405GWh in 2026, representing a 25%py increase.

A similar rate of growth is forecast for energy storage systems (ESS). Emissions objectives again play a role, but so does the economics of electricity grid management where increased storage may reduce other costs relating to generation and to the network. For the consumer, storage offers the opportunity to reduce electricity costs and to benefit fully from self-generation. Roskill forecasts an ESS market for Li-ion batteries of 13GWh in 2025, up from 2GWh in 2016, but its growth trajectory could change more quickly as costs fall and renewable energy up-take rises.

The accuracy of any automotive electrification forecast will depend largely on how closely developments in xEVs match expectations. Government resolve, cost and performance trends in batteries and the strategy of automotive companies are all important variables here. Compare President Trump's stance to emissions targets versus China for example. Similar comments apply also to ESS, another high growth market. High/low scenarios and the drivers are therefore vital to assess the upside and downside risks.

Lithium hydroxide to benefit from changing battery chemistry

Li-ion battery cell assembly draws upon a complex supply chain of largely unrelated product groups, within which nonferrous metals and minerals play a major role. Important materials groups include cathode materials, anode materials, electrolyte, separators and current collectors. Li-ion batteries are normally specified by cathode chemistry. The alternative chemistries, and specific formulations within them, offer a very wide range of power, energy, safety and cost options appropriate to different applications.

With the growing emphasis on xEV and ESS markets, demands on materials suppliers are changing. This is very evident in cathode materials, where the market has shifted away from high-cobalt LCO cathode typically used in portable electronics to nickel-rich products, primarily NMC but also NCA, which offer higher energy density per unit of mass and volume. Another xEV material, LFP, has been used extensively in China, but is now losing ground to NMC and NCA although it remains favourable for eBus, HEV and ESS applications. When cathode nickel content exceeds 50%, or manufacturers use a sol-gel method of LFP cathode manufacture, lithium hydroxide is the favoured lithium feedstock. Lithium hydroxide will therefore outpace carbonate demand growth.

Alongside the uncertainty over market growth rates, technological developments also present a risk to product demand in future. Li-ion technology is approaching the upper bounds of practical energy density, with only a 20-30% improvement likely before the buffer is hit. Current research and trends suggest that solid-state Li-ion batteries and lithium-sulphur batteries will be the next improvements and might achieve mass commercialisation in the mid-2020s. This will mean a shift in material requirements to lithium metal and lithium sulphide, although solid-state retains a mixed metal cathode. Lithium producers shouldn't rest too easily versus their cobalt or nickel counterparts, however, as an entirely different battery technology could wipe lithium out, but as yet no strong contenders on price/performance have emerged as viable alternatives.

Rapid developments in the lithium supply chain incentivised by price increases

The increase in lithium prices from end-2015, combined with a growing realisation that vehicle electrification is finally happening en masse after several false starts, has caused a rush in companies staking, purchasing, evaluating or expanding lithium assets. An additional 370,000tpy LCE of lithium production capacity has been identified by Roskill as scheduled to come online at existing and new operations by 2020, although it is unlikely all of this capacity increase will be realised. Around 250,000tpy LCE of capacity (factoring utilisation rates and ramp-up) will be needed just to satisfy battery market growth alone at current projections. That is double current capacity, and equivalent to two sizeable projects a year. Any hiccups will reverberate through the supply chain, and consumers are not currently doing enough to ensure their future supply chain. Competition and shortages mean higher prices, and a

return to mid-single digit pricing is unlikely given the incentive needed to get projects to production. Lithium developers have mistimed demand in the past, and it is the downside – and memories of the supercycle peak - that is putting investors off financing projects despite the equity boom.

Major existing lithium producers including SQM, Albemarle and Tianqi Lithium have all announced plans to increase output of lithium. The Greenbushes mine in Western Australia, the largest lithium hard-rock mine in the world - owned by Tianqi Lithium and Albemarle - announced a scheduled capacity expansion from 95,000tpy LCE to 165,000tpy LCE by H2-2019, an increase of over 42%. The increased output is expected to supply Tianqi Lithium's new 24,000tpy lithium hydroxide plant in Western Australia planned for commissioning in 2018 and Albemarle's newly-acquired Chinese conversion assets which are being expanded. In South America, Albemarle announced plans to increase production capacity at the Salar de Atacama operation by 45% to 80,000tpy LCE, after receiving extended permits from the Chilean government. SQM has also announced plans to increase processing capacity at the Salar de Carmen plant near Antofagasta, and is contributing to the 50:50 joint venture it has with Lithium Americas in the Salar de Cauchari brine project due online in 2019.

Existing and new producers have encountered issues with ramping up output of lithium compounds, meaning contingency for delays needs to be factored in. In Argentina, Orocobre has reduced its production targets for battery grade lithium compounds in H1 2017, although it plans to increase output to full capacity in the second half of the year. Lithium brine operations in China, based predominantly in Qinghai province, have struggled with unfavourable brine chemistries, but the implementation of new processing methods by new owners in 2017 could resolve these problems and allow Chinese brine producers to increase output. Galaxy Resources and Quebec Lithium tried and failed to establish alternative lithium supply from mineral sources in the early 2000s, but are now trying again under new management.

The emergence of new mineral producers in Australia during 2016 has improved the availability of lithium feedstock to Chinese mineral converters previously reliant on Talison. Galaxy Resources and Neometals began shipments of lithium mineral concentrates to customers in China at end-2016, with approximately 45,000t LCE forecast to be shipped in 2017. The improved diversity of mineral concentrate supply into China is expected to alleviate supply-side pressure and contribute to an easing in Chinese domestic lithium prices. Chinese mineral converters continue to seek new raw material sources, signing supply contracts for unprocessed (direct shipping / DSO) lithium ores from the Wodgina mine operated by Mineral Resources and Pilbara's planned Pilgangoora mine, both in Australia. Mineral Resources intends to ship up to 50,000tpy LCE contained in unprocessed ores to China, though this will be reduced after recovery rates in concentration and processing are applied. Whether Ruifu, the buyer, can process DSO effectively given the challenges Galaxy and Neometals have had in processing in Australia remains to be seen.

Longer-term lithium supply picture expected to change considerably

Increased output by SQM and Orocobre in South America, coupled with increased production from Talison in Australia and a rise in Chinese domestic output, moved the lithium market from a supply deficit in 2015 to marginal oversupply in 2016. Mine supply is likely to exceed demand in 2017, but refined output will lag. The overall supply-demand balance for lithium is not representative of the industry as a whole, however, as specific products are required by lithium's varied end-use applications, not least hydroxide for Li-ion battery cathodes much of which is still produced using lithium carbonate feedstock. Simply put, in 2015 and 2016 there was not enough lithium of the required type to feed a battery industry that jumped in lithium demand by 75% in two years.

The diversity and availability of lithium supply is expected to, and will have to, improve further towards the 2020s as a number of new lithium projects are advanced. The shift to Tier 2 assets, with more complex resources, and the need to produce more hydroxide, has catalysed the emergence of new extraction technologies. Leading this charge is Nemaska Lithium in Canada using electrolysis of mineral-derived sulphate solution to produce hydroxide, while Enirgi, POSCO and Eramet in Argentina plan to use direct brine extraction methods to produce lithium carbonate. Lepidolite is seeing increased attention, after Chinese converters proved in 2016 you can make a viable business processing it in a high price environment, with companies such as Lepidico pursuing lepidolite conversion outside China.

Meanwhile Rio Tinto is pursuing evaluation of jadarite mining in Serbia, a major resource but one that has not been tapped for its lithium before. Risks remain, as no new technology, whether mineral- or brine- based, has yet achieved large scale.

With significant growth potential from automotive batteries, lithium will remain an attractive market and see high levels of investment in new production in coming years. The market is currently too small and consolidated on the supply side to have been subject to the trading activity seen in other minor metals or chemicals, depending how you classify the product, but this may change as developers, financiers and users seek to reduce price risk. The crossover with cobalt and nickel in batteries, which are more highly traded commodities, may also present an opportunity for the trading community to get involved. It is conceivable that lithium will also feature on a global exchange in future, but preceeding that perhaps a benchmark pricing system.

Contributors: **Robert Baylis and David Merriman**, Roskill Information Services, UK. Roskill's Lithium: Global Industry, Markets and Outlook report was published in May 2017.

Contact info@roskill.com for more information.

The MMTA's Inaugural Golf Day was hosted at the world renowned K Club and kindly sponsored by ICD Alloys & Metals LLC.

Congratulations to all the winners!

Texas Scramble

1st: Mr Steve Conlin, Mr Ian Machent, Mr Mao Yuting, Mr Lin

2nd: Mr Rob Wallace, Mr Nick Cartwright, Mr Tobias Strathmann, Mr John McDonald

3rd: Mr Duncan McVicar, Mr Colin Strang, Mr Jim Brancho

Longest Drive: Mr Steve Conlin

Nearest The Pin: Mr Ian Hogg

Longest Putt: Mr Steven Whitehead

Computers Create Recipe for Two New Magnetic Materials

Material scientists have predicted and built two new magnetic materials, atom-by-atom, using high-throughput computational models. The success marks a new era for the large-scale design of new magnetic materials at unprecedented speed.

The relative scarcity of magnetic materials can make them expensive or difficult to obtain. The traditional process involves little more than trial and error, as researchers produce different molecular structures in the hope of finding one with magnetic properties. Many high-performance magnets, however, are singular oddities among physical and chemical trends that defy intuition.

In a new study, materials scientists from Duke University provide a shortcut in this process. They show the capability to predict magnetism in new materials through computer models that can screen hundreds of thousands of candidates in short order. And, to prove it works, they've created two magnetic materials that have never been seen before.

Considering all the possible combinations and arrangements available using 55 elements, the researchers had 236,115 potential prototypes to choose from. To narrow the list down, the researchers built each prototype atom-by-atom in a computational model. By calculating how the atoms would likely interact and the energy each structure would require, the list dwindled to 35,602 potentially stable compounds.

From there, the researchers conducted a more stringent test of stability. Generally speaking, materials stabilize into the arrangement requiring the least amount of energy to maintain. By checking each compound against other atomic arrangements and throwing out those that would be beaten by their competition, the list shrank to 248.

Of those 248, only 22 materials showed a calculated magnetic moment. The final cut dropped any materials with competing alternative structures too close for comfort, leaving a final 14 candidates to bring from theoretical model into the real world.

For the synthesis, Curtarolo and Oses turned to Stefano Sanvito, Professor of Physics at Trinity College in Dublin, Ireland. After years of attempting to create four of the materials, Sanvito succeeded with two. Both were, as predicted, magnetic.

The first newly minted magnetic material was made of **cobalt, manganese and titanium** (Co2MnTi). By comparing the measured properties of similarly structured magnets, the researchers were able to predict the new magnet's properties with a high degree of accuracy. Of particular note, they predicted the temperature at which the new material lost its magnetism to be 940 K .

The second material was a mixture of **manganese, platinum and palladium** (Mn2PtPd), which turned out to be an antiferromagnet, meaning that its electrons are evenly divided in their alignments. This leads the material to have no internal magnetic moment of its own, but makes its electrons responsive to external magnetic fields.

While this property doesn't have many applications outside of magnetic field sensing, hard drives and Random Access Memory (RAM), these types of magnets are extremely difficult to predict. Nevertheless, the group's calculations for its various properties remained spot on.

This work was supported by the Science Foundation of Ireland, the EU Commission and the National Science Foundation (DGF1106401).

"Accelerated discovery of new magnets in the Heusler alloy family." Stefano Sanvito, Corey Oses, Junkai Xue, Anurag Tiwariy, Mario Zic, Thomas Archer, Pelin Tozman, Munuswamy Venkatesan, J. Michael D. Coey, and Stefano Curtarolo. Science Advances, April 14, 2017. DOI: 10.1126/sciadv.1602241

Source: Duke University

The ICD Group is pleased to announce the formation of ICD Europe Ltd, a European subsidiary of the ICD Alloys & Metals division. Experts in the procurement and supply of Primary metals, Superalloys and Minor metals.

Our purpose-built facility is based in the heart of the British steelmaking and metallurgy industry in Sheffield. ICD Europe is perfectly positioned to cater for customers in the UK and across Europe. The European facility will be headed up by our Managing Director, Wayne Hawkes. He, along with his team, has many years of experience working closely with clients across varied industrial sectors, including the aerospace, oil & gas, medical, petrochemical, automotive and electronics industries.

Our Products

Building on the ICD Group's existing global supply chain and 65 years of experience in commodity trading, ICD Europe are responsible for supplying a wide range of different specialised metal products, including:

- Nickel and Cobalt Superalloys
- Minor metals including Tantalum, Hafnium, Rhenium, Molybdenum, Tungsten & Niobium
- Ferroalloys
- Rare earth elements
- Intermediates and oxides.

Our Services

From our purpose-built facility, we can offer our clients a variety of different bespoke service packages including:

- Bar cutting
- Sorting, testing and segregation
- Processing of revert to vacuum standards
- Certified mutilation of engine run parts
- Precious metal reclamation
- Bespoke blends and melting
- Toll processing and recycling of Hafnium, Tantalum and Rhenium concentrates and revert
- Consignment supply solutions
- Flexible and bespoke supply and pricing mechanisms to suit individual clients.

ICD are proud to promote and guarantee mine to market ethically sourced materials and are approved through the CF2000 program.

Through our global supply chain and strategically located offices, we can offer a wide range of different products and services in addition to those listed above. If your requirement is not listed, please get in touch and a member of our team would be happy to discuss what we can offer.

www.icdeurope.com **+44 (0) 1709 918 120** **admin@icdalloys.com**

LETTER FROM NORTH AMERICA

Dear Members

I seem always to start my letter with the weather here in New York. So, why break with a tradition?

You'd hardly think it's May it's so chilly. But then, on the basis of how it's been since I last wrote, you'd really have no idea what season (or month) it is. Just the other week it was well over 80°F on the Tuesday and just above freezing on the Thursday. I fear this is how it's going to be going forward.

This uncertainty about the weather mirrors somewhat the currently uncertainty about what many of President Trump's policies actually are. I think that this is perhaps no more apparent than when it comes to trade agreements. NAFTA: Stay in? Pull out? Revise? Who really knows? However, following fierce lobbying from lawmakers and business leaders, it appears that pulling out of NAFTA anyway is, now, off the cards – for the time being.

And, while TPP certainly looks dead, if Wilbur Ross, the U.S. Commerce Secretary, is to be believed, TTIP does not appear to be. But, when any negotiations with the EU might be resumed remains an unanswered question. What with Brexit negotiations coming up and German elections, it's unlikely to be any time soon.

Back at the end of March, I touched briefly on Dodd-Frank and conflict minerals. On April 7, as had been anticipated, the SEC's Division of Corporation Finance issued an Updated Statement on the Conflict Minerals Rule. On the same day, SEC Acting Chairman Piwowar published a separate Statement.[1]

According to law firm Ropes & Gray: "The Statements will have little impact on the calendar year 2016 traceability process at most registrants. In most cases, that process has been completed or is close to completion." [2]And: "For most registrants, the most immediate considerations will be how much to say in the calendar year 2016 Form SD, and whether to include a separate Conflict Minerals Report exhibit."[3]

Going forward, however, the fate of the rule remains very uncertain. If the reaction of Kara Stein, the other SEC Commissioner and a Democrat, is anything to go by, any changes to the rule will be fought over fiercely. According to Ms Stein, Mr Piwowar's overreach "unilaterally" undermined a rule "mandated by the Congress, adopted by the commission, and reviewed by the courts."[4] We shall see.

As always, I try to pass on to members anything interesting I find on the scientific discovery front involving minor metals. Here are two advances that I found particularly interesting.

Over in the West, at Arizona State University, gallium, my old favorite, is back in the news, perhaps not so surprisingly in the field of solar cell technology. According to a research paper published by electrical engineering Assistant Professor Yuji Zhao, gallium nitride has exhibited great potential as a material with which to create "a high-performance solar cell capable of operating under extremely high temperatures."[5] Professor Zhao has no doubts about gallium nitride performing. He's interested in "how efficiently they [panels] will perform."[6]

At the U.S. Department of Energy's Lawrence Berkeley National Laboratory, researchers have been doing some fascinating stuff with the semiconducting material chromium germanium telluride ($Cr_2Ge_2Te_6$, or CGT).[7] According to a Science Daily article describing the research: "The scientists found that a 2-D van der Waals crystal, part of a class of material whose atomically thin layers can be peeled off one by one with adhesive tape, possessed an intrinsic ferromagnetism."[8] This could have major implications in such areas as nanoscale memory, spintronic devices, and magnetic sensors.

For those members whom may have forgotten: "Van der Waals forces, named after a Dutch scientist, refers to intermolecular forces of attraction that do not arise from the typical covalent or ionic bonds that keep molecules intact. These quantum forces are used by geckos as they effortlessly scamper along walls and ceilings.

"Van der Waals crystals describe materials in which the 2-D layers are not connected to each other via traditional bonds, allowing them to be easily exfoliated with tape. Research on graphene, the most well-known van der Waals material, earned the Nobel Prize in physics in 2010."[9]

What's also really exciting and was noted by the researchers is that "...a striking feature of van der Waals crystals is that they can be easily combined with dissimilar materials without restrictions based on structural or chemical compatibility."

Pretty "cool, eh?!"

With an exhortation to read the article I quote from (reference below), I remain, with best wishes from New York

Yours, as always

Tom Butcher , May 7th, 2017

Tom Butcher is an Associate Director at Van Eck Associates Corporation ("VanEck"). The views and opinions expressed herein are the personal views of Tom Butcher are not presented by or associated with VanEck or its affiliated entities.

[1]Ropes & Gray: *SEC Issues Updated Statement on Conflict Minerals Rule* (April 10, 2017), https://www.ropesgray.com/newsroom/alerts/2017/04/SEC-Issues-Updated-Statement-on-Conflict-Minerals-Rule.aspx

[2]Ibid.

[3]Ibid.

[4]The Wall Street Journal: *Companies Get More Leeway on SEC 'Conflict Minerals' Rule*, (April 10, 2017), https://www.wsj.com/articles/companies-get-more-leeway-on-sec-conflict-minerals-rule-1491605276

[5]Energy Harvesting Journal: Improving next-gen materials for solar cells (May 2, 2017), http://www.energyharvestingjournal.com/articles/10955/improving-next-gen-materials-for-solar-cells

[6]Ibid.

[7]Science Daily: New atomically layered, thin magnet discovered (April 26, 2017), https://www.sciencedaily.com/releases/2017/04/170426131026.htm

[8]Ibid.

[9]Ibid.

Non-ferrous Metals Manufacturing: Vision for 2050 and Actions Needed

The EU Commission's recently published report, to which the MMTA contributed during 2016, outlines the objectives of the Commission to strengthen the EU's industrial base towards 2050, and the role of non-ferrous metals manufacturing in this vision. The EU aims for 20% of GDP to be from 'industry' by 2010.

The European non-ferrous metals manufacturing industry is an important and strategic sector directly employing 500 000 people and supplying products for numerous crucial downstream industrial sectors, such as transport, energy production, construction and aeronautics, to name a few. Its investment horizon spans over decades and is thus particularly in need of adopting a long-term strategic perspective. The objectives are as follows: firstly, it aims to define a long-term vision for the non-ferrous metals manufacturing industry: it proposes indeed an aspirational, achievable and clear view of where the sector aims to be in 2050. Secondly, the goal is to propose concrete actions that the industry itself, but also policy, research and other stakeholders can take to address the challenges faced by the sector on its path towards the vision.

Methodology The study used a highly participatory, qualitative methodology: two workshops were organised and gathered representatives of the non-ferrous metals industry, research institutions, policymakers, trade unions and stakeholders from upstream and downstream sectors—including the MMTA. The Industrial Landscape Vision, in particular, was used as a tool to prompt future, systemic thinking among the workshop participants. Virtually all insights generated in this report come from the collective interactive discussions that took place during these two workshops, along with a thorough literature review.

Key conclusions The vision statement states that, by 2050, the non-ferrous metals manufacturing industry aims at being a valued and trusted world leader in delivering sustainable, innovative and competitive non-ferrous metals based solutions traded globally. It intends to be a key player in closing resources loops, in acting and setting the bar for the highest social, environmental and ethical standards, in meeting evolving customer and societal needs while bringing social benefits through investments in Europe and top environmental performance, increasingly relying on renewable sources of energy and retaining and developing essential skills and knowhow. Four clusters of challenges were identified as relevant for the sector to reach its vision, along with appropriate actions to address them:

(1) **Trade and competition** The lack of a level-playing field, mainly due to different environmental and social standards and different energy costs across regions, is a crucial challenge for the sector to be a world leader. For some non-ferrous metals, the sector's dependence on import of raw materials is also problematic, especially given that it is a price-taker. Proposed industry actions to address these challenges include defence measures against protectionism, vulnerabilities and volatility, differentiating non-ferrous metals products through quality, ethical and environmental added value and geographical expansion. There is a call for policy to further develop trade policies favouring a level-playing field, including enhancing transparency in the global pricing of raw materials, developing trade defence measures, and further negotiating free trade agreement to offset protectionism. European standards are a key component to address the identified challenges, by not only setting them but also promoting them at international level and ensuring their harmonised enforcement.

(2) **Innovation** The non-ferrous metals industry faces some challenges to reach the innovation component of its vision: it is a relatively old industry and only indirectly meets end-consumers' needs. It also faces challenges related to investment leakages and the difficulty to roll out innovations. Embracing a culture of innovation to better understand end-consumers' needs, thinking systematically across the value chain, collaborating with smaller players in the downstream sectors, and using communication and marketing tools all contribute to the industry's efforts to develop and sell innovative solutions. Technological innovations are also crucial: they include, for instance, hybrid solutions combining non-ferrous metals and new composites, smart materials with embedded intelligence, new processes allowing flexible manufacturing and big data analysis. Policy has a central role to play by providing a long-term innovation and investment-friendly support to the industry, not only at the early stages of the research and development process. There is also a call for more flexible and adaptable regulations regarding materials classification to allow a quicker deployment of innovations.

(3) **Resources** The vision's objectives of closing resources loops in a circular economy perspective, of increasing energy efficiency, and of relying on renewable energy sources, face several challenges. Regarding circularity, they relate to the proper collection, disassembly and reprocessing of scrap in line with the highest environmental and social standards. The issues around energy encompass, among others, the intermittent nature of renewables and the difficulty to store energy in a cost-effective way. To address the circularity challenges, the industry should take full control of materials throughout the value chain by developing, for instance, take-back schemes and toll contracts. The industry ought to raise public awareness regarding the value of secondary materials and the need to sort and return them. Regarding energy, reducing its costs, investing in energy efficiency, acting as a virtual battery or as a grid stabiliser and pressuring for competitive prices for renewables are other possible actions. Technology is crucial to improve recycling processes and to trace and capture secondary raw materials. As to policy actions, deploying the full potential of the Energy Union, understanding and incentivising consumer's behaviour for scrap sorting and collection, and adopting risk-based

rather than hazard-based regulations are among the actions proposed.

(4) **Business integrity and skills** In order to be a trusted world leader, the non-ferrous metals sector faces challenges regarding its image, hampered by the sometimes poor social and environment conditions of primary raw materials production in third countries, the perceived negative environmental impacts of the industry and the misconceived scarcity of non-ferrous metals. The industry needs to invest further in raw materials traceability and transparency, in internal audit and external accreditation, as well as in communication efforts to showcase success stories, raise awareness of the importance of the sector and re-brand it. Policy actions can also contribute by developing global standards on responsible sourcing and identifying responsible suppliers, supporting fair trade, and mapping areas of conflict materials.

To retain and develop its essential skills and know-how, the industry faces similar image challenges that hamper its ability to attract qualified skills, as well as specific challenges regarding the transmission and the up-skilling of knowledge. The sector itself may improve pay and working conditions and promote gender equality to attract talent. Internal trainings, joint initiatives with vocational educational institutions and joint research and doctoral programmes with universities are also identified as tools to preserve and develop skills.

Source: European Commission

The full report: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/non-ferrous-metals-manufacturing-vision-2050-and-actions-needed

In Brief

Armour for Vatican guard

Austrian blacksmiths who produce ceremonial suits of armour for the Vatican's Swiss Guards are close to the end of their current deal to do so, and say supplying the suits will not now be an issue for many years to come.

One of the drawbacks of the Swiss Guards' medieval uniforms is that the craftsmanship needed to make them is disappearing.

Faced with an aged stock in need of replacement, they turned to brothers Johann and Georg Schmidberger - the fifth generation to run the family blacksmith's business in the Austrian town of Molln - to provide them with 80 suits of armour covering the torso and arms.

The brothers have produced 10 of the suits a year since 2009, meaning the deal will be completed this year, and new replacements will not be needed for quite some time.

"I think it won't be an issue for another couple of hundred years," Johann said.

The brothers' workshop, where all kinds of hammers are piled high near a furnace and anvil, will continue to supply swords, locks, gates and other items to customers including theatres and private collectors.

A Swiss Guard's ceremonial helmet

And, for the coming years at least, he and his brother will produce the Guards' distinctive crested helmets, he said.

Organo-metal compound attacks cancer

The University of Warwick, UK, has for the first time targeted and destroyed cancer cells using an organo-metal compound. The compound is organo-osmium FY26, which kills cancer cells by locating and attacking their weakest part. The researchers looked at the effect of the compound in ovarian cancer cells. Metals which are produced naturally by the body, such as zinc and calcium, moved around the cells. Calcium is believed to help the FY26 to achieve an optimal position for attacking the cancer.

- FY26 is 50x more active than metal drugs used in current cancer treatments
- Unprecedented minute detail of cancer cells seen with nano-imaging at European Synchotron

Source: University of Warwick

We have an experience of over 20 years in import-export and distribution of raw materials (ferroalloys, non-ferrous metals, pig iron, etc.) for the metallurgical and machine construction industry.

We trade the following products:

BULK FERROALLOYS
Ferrosilicon, HC/LC Ferromanganese, HC/LC Ferrochrome, Silicomanganese, Silicocalcium, Ferrophosphorus, etc.

NOBLE FERROALLOYS
Ferromolybdenum, Ferrovanadium, Ferroniobium, Ferrotitanium, Ferrotungsten, etc.

NON-FERROUS METALS
Nickel, Tin, Chromium Metal, Silicon metal, Manganese Metal, etc.

CALCIUM FLUORIDE (CaF2)

FOUNDRY PIG IRON

CHROMITIC SAND

ANTHRACITE & COKE

GRAPHITE ELECTRODES

Call us on: +40 21 230 01 54

Email us at: office@euroinvest.com.ro

Website: www.euroinvest.com.ro

EXOTECH inc.

For Over 26 Years

Conflict Free Certified + ISO 9001

STOCKING SUPPLIER OF RECYCLED

PURE AND ALLOY

Tantalum	Niobium	Molybdenum
Tungsten	Hafnium	Zirconium
Chromium	Nickel	Cobalt
Vanadium	Indium	Other Exotics

All processing and quality assurance in house

PRODUCER OF

HIGH PURITY CHROMIUM POWDER

Purity 99.8% to 99.98% • Size -3 to -325 mesh

and

SYNTHETIC TANTALUM CONCENTRATES

SPECIALIZING IN

HIGH PURITY SPUTTER TARGET ALLOYS

RECYCLING UNIQUE TANTALUM REFINERY

Exotech, Inc.
1851 Blount Road
Pompano Beach, FL 33069

Tel: +1 (954) 917 1919
Fax: +1 (954) 917 3033
Exotech@exotech.com

www. Exotech. com

ISO 9001:2008 CERTIFIED