

T I C

TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Dear Fellow T.I.C. Members and Friends,

As I write this, the fall foliage here in New England is slightly past its peak, but still breathtaking. As the nights are getting longer and colder, we realize the cyclical nature. We can sometimes see the same rhythms in our business, as these are clearly both interesting and challenging times for the tantalum and niobium industries.

This could be demonstrated in what looks to be a somewhat lower than initially expected turnout for our upcoming General Assembly in Penang, Malaysia, hosted by MSC, although the numbers registered so far are still encouraging. I would urge all of our members, who have not yet done so, to register for this event, particularly as the weather in Penang then will be a lot more balmy than many of us are currently experiencing.

Your Executive Committee has been diligently working on several initiatives, as we are constantly aware we need to provide a proper value proposition for you, our members. We look forward to discussing many of these in more detail during a special session of our General Assembly. These will include presentations and discussions by the four special subteams we have established so far, including:

- updating of the T.I.C. website, headed up by Dan Persico;
- staffing, led by Bill Millman;
- meetings, with David Gussack in charge; and
- supply chain, with your President at the helm.

There have also been some interesting developments over the last several weeks, which we will talk about in much more detail in Penang. These are areas which we believe are vital to the long term health and viability of our industry. Some selected examples include:

- the recent notifications about at least two thefts of Rwandan coltan destined for China, where concrete bricks were substituted for the ore, possibly in the private part of the port of Dar es Salaam, Tanzania. Your ExCom is working diligently with various organizations, such as iTSCi and the EICC/CFSI, and selected government entities to attack this scourge. We are seeking ways to both better publicize the thefts in Dar es Salaam as well as address the incentive for downstream processors to procure this discounted material;
- we have received formal applications from a range of attractive candidates for the planned position of a new Director. The subteam is in the midst of interviewing these individuals and we hope to make a decision later this year;
- as there remain many myths and misinformation about both Ta and Nb, your ExCom believes it is incumbent on us to start to address these. We need to do a better job both promoting our industry and educating the consuming public. This also includes starting to deal in a more significant manner with relevant government organizations, whether it's regarding pending regulation or matters of policy that impact our industry- in the US, the EU, China, or elsewhere.

In short, there are many interesting developments that will impact the industry and therefore you, our members. As such, we will continue to pursue such matters, as well as initiate action, in order to influence the direction and results of such. However, as always, we can only do so with your suggestions, input, criticisms, questions, and advice.

I look forward to seeing you in Penang.

Yours sincerely,

David R. Henderson

President

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FIFTY-SIXTH GENERAL ASSEMBLY

The Fifty-sixth General Assembly and associated technical meeting of the T.I.C. will be held in Penang, Malaysia, from Sunday October 25th to Wednesday October 28th 2015. The conference will take place at the Shangri-La Rasa Sayang Resort.

On Sunday October 25th, the registration desk will be open from 10a.m. to 1p.m. and 2p.m. to 5p.m. All participants are invited to a Welcome Reception that evening, from 6p.m. to 8p.m.

The formal General Assembly of the association will be held at 9a.m. on Monday October 26th.

The General Assembly will be followed by presentations dedicated to each of the four subteam initiatives currently ongoing within the T.I.C. (website revision, T.I.C. staffing, General Assemblies and supply chain initiatives). This special session, restricted to delegates from member companies, is scheduled until noon.



Image courtesy of Rasa Sayang Resort

Lounge, Rasa Sayang Resort

After a break for a buffet lunch, technical presentations will extend until mid-afternoon.

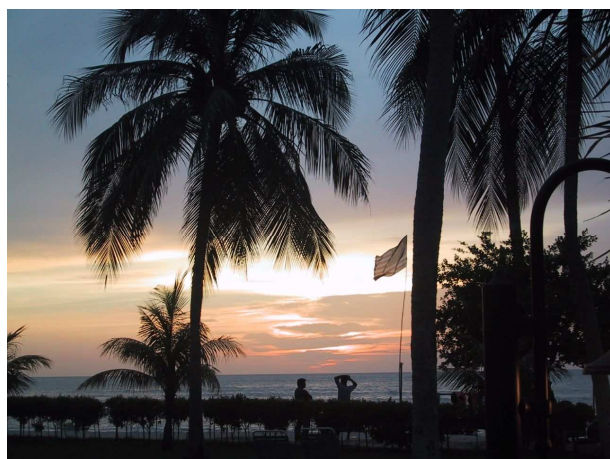
On Monday evening, all participants are invited to a Gala Dinner to be held in a marquee in the gardens of the hotel.

A further technical session will be held on Tuesday October 27th, breaking for a buffet lunch and ending mid-afternoon. The abstracts of all the technical presentations are published here below.

On Wednesday October 28th, delegates will be given the opportunity to visit the facility of Malaysia Smelting Corporation, located in Butterworth, around one hour away from the hotel.

Tours for accompanying persons are also being arranged:

- a full-day tour on Monday, discovering George Town, a UNESCO World Heritage site. After a stop at Fort Cornwallis, built in 1808, the group will ride on trishaws down the Street of Harmony where all the different religious worship places can be found on one road: Masjid Kapitan Keling (Muslim Mosque), Chinese Goddess of Mercy Temple, St. George's Church (Anglican), Sri Mahamariamman Temple (Hindu) and the Cathedral of Assumption. Next stops will be Khoo Kongsi, a large Chinese clanhouse, then the walkway of Clan Jetties, unique Chinese settlements that have been around since the 19th century. Along the wooden pier are villages on stilts that house the descendants of Chinese immigrants. After lunch, the group will proceed to visit the world-renowned Pinang Peranakan Mansion, offering a glimpse into the Peranakan customs and traditions, then Wat Chayamangkalaram, home to a 33 meter long statue of a reclining Buddha swathed in gold. Last but not least, participants will experience pewter making at the Royal Selangor's School of Hard Knocks where they will craft their own pewter bowl to take home.



Sunset, Rasa Sayang Resort

- a half-day tour on Tuesday: the first discovery will be a tropical fruit farm, developed in 1993, with an orchard covering 25 acres. Then the group will visit one of the largest hand-made batik factories in Northern Malaysia, learning how to draw with hot wax and blend colors to create a unique batik design, before taking home the batik fabric just created. Finally, the group will visit a tropical spice garden, South East Asia's only dedicated spice sanctuary.

The following papers are expected. The announced presenter is the first author listed, unless otherwise specified. The papers are shown in the expected running order.

Responsible sourcing: roadmap to a sustainable supply chain for tin and tantalum

by Raveentiran Krishnan and Chua Cheong Yong, Malaysia Smelting Corporation

Responsible sourcing will have to go hand in hand with sustainable supply chain failing which there is little chance for any venture to survive. Companies must leave the comfort of their home base to the ground where their feed materials are mined. One should go beyond regulatory requirement and be guided by moral obligation to see that every actor in the supply chain right from the mine hole to the smelter has a fair and equitable share of mineral wealth and is free from any form of unjust and abuse committed by any group of people. The situation on the ground has improved thanks to the multitude of collective efforts by various organizations. In the absence of strong governance, companies must chart their own roadmap to ensure sustainable feed stream which meets or exceeds the transparency and traceability scheme in place which has lifted the miners from abject poverty to some degree of dignity where they can now earn a decent sum to feed their family. The areas which were once the bastion of various rebel groups are now transforming to resource centres. The infrastructure and quality of life are being lifted by the mineral wealth which has been ploughed back to the very place where it has been mined. An entire generation can look forward to the future with hope. Companies, civil societies and all other stakeholders must continue their efforts to expand this to a wider swath of land for the benefit of all.

Conductive polymer based tantalum capacitors for automotive applications

by Jane Ye, Chris Stolarski and Mel Yuan, KEMET Electronics (Suzhou) Co. Ltd

The tantalum solid electrolytic capacitor in combination with an intrinsically conductive polymer cathode has gained widespread use in the electronic industry thanks to its low series equivalent resistance (ESR) and benign failure mode. In the last several years, conductive polymer based tantalum capacitors have begun to be used in medical, avionics and military designs given the level of performance and reliability these devices have demonstrated in the field. The automotive industry started to adopt this new type of tantalum capacitor in the infotainment and driver assistance applications. This paper will describe the demanding performance challenges to the polymer tantalum capacitor by the high temperature and high humidity operating environment in a vehicle, the material and process advancement to overcome these challenges, as well as the electrical performance and reliability of the newly launched tantalum capacitor. Our effort to develop 125°C capable polymer tantalum capacitor with 1000 hour endurance at 85°C and 85% relative humidity (full qualification of AEC Q200) will be discussed. The next level of high performance polymer tantalum capacitors to sustain 150°C or even higher temperatures is expected in the near future. This will further enhance the utilization of polymer tantalum capacitors in other industries where harsh conditions are of concern.

Biomedical porous tantalum synthesized via 3D wire frame and chemical vapour deposition

by Lu Dong, He Jilin, Wang Li, Marko Huttula, Li Bin, Shi Wenfeng and Cao Wei, CNMC Ningxia Orient Group (presented by Chen Wu)

Porous tantalum is a surgical implantation material similar to human bone structure and human bone physical properties. It has been proven to be one of the most suitable substitution materials for human bone. It was either synthesized by metallic powder sintering or chemical vapour deposition deposited on vitric carbon framework. In this article, we introduce a novel synthesizing route of forming porous tantalum with high porosity through 3D knitted wire framework and chemical vapour deposition. The raw materials are tantalum wires, bent into specific shapes. A porous metallic frame is constructed by the bent wires. The metallic frame is further consolidated by the tantalum film which is reduced from tantalum chloride by hydrogen gas. The porous tantalum is totally permissive. The porosity exceeds 85% and the diameter of pores varies from 0.2 to 1 mm. The pore size, porosity, compressive strength and the Young's modulus can be modified by the thicknesses of tantalum film and the structure of the knitted framework. Medical application in vivo experiments and optimizing of structure will be carried out in the future.

Tantalum market trend

by Hiroaki Yoshinaga, Advanced Material Japan Corporation

We will summarize the picture of the macroeconomic situation in Japan, and the current situation of supply/demand for tantalum and niobium. There are many factors influencing these: Abenomics, weak Japanese Yen exchange rate, high stock price on the Tokyo stock exchange, high demand for construction aiming for the Tokyo Olympics in 2020... At the same time, we will summarize the current situation of each application related with tantalum and niobium demand: tantalum capacitors, optical glasses, super alloys, SAW devices, sputtering targets for semiconductors. Tantalum demand continues even though the market price has increased since 2007, and applications are changing to high-tech applications with high value added products. The Japanese market forms a significant portion of the tantalum world, and the economic situation gives a better environment for export business, which has been created by Abenomics to stimulate the Japanese economy and stock exchange price. Our report will summarize what impact has been caused and how the Japanese economy goes.

Statistics and more statistics: what are they and where do they come from?

by Ulric Schwela, Tantalum-Niobium International Study Center

T.I.C. statistics are gathered and published to members every quarter, but where do they come from? What do they represent? The presentation will first outline the context from which T.I.C. statistics are collected, including a layout of reporting membership types, their interconnection, and where reporting rules are applied to avoid double counting.

What other statistics for niobium and tantalum are there besides T.I.C. figures? The presentation will outline some of the other sources of statistics, which can be seen as complementary to the T.I.C. data, such as international trade data recorded by Customs. Based on standardised international product classifications, such data can be compared, provided of course that the classifications are both matching and sufficiently detailed, and examples of comparison limitations will be given.

Finally the presentation will provide an overview of the T.I.C. data over a number of years for:

- niobium raw materials
- niobium products from processors
- tantalum raw materials
- tantalum receipts by processors
- tantalum products from processors
- tantalum receipts by capacitor makers

Miniaturization of chip tantalum capacitors

by Daisuke Takada, NEC TOKIN Corporation

The main feature of tantalum capacitors is their high capacitance compared to unit volume. In recent years, ceramic capacitors, MLCC, have expanded their market because of small volume and cost performance. But MLCC have some performance limits. MLCC have problems with acoustic noise under AC signal, and capacitance changes when applied voltage and ambient temperature are changed, resulting in characteristics stability problems. Tantalum capacitors are more stable and show little variance in capacitance. There is a steady demand for these characteristics in the desired end-use, such as wearable electric equipment or handy medical equipment. Also MLCC have a crack mode failure problem from PCB board flex. Thin MLCC are hard to manufacture, but we can manufacture thin tantalum capacitors.

This report explains the miniaturization of tantalum capacitors, and small, thin case size products for the expanding market. We developed high precision assembly technology and new terminal structures such as 'substrate structure' for the small case size. And we developed application engineering of HiCV tantalum powder for high capacitance in small case size. Development of HiCV tantalum powder is a very important factor for the thinner and smaller technology of tantalum capacitors.

We report on the miniaturization and thinning progress of tantalum capacitors, from the past to the future. We will explain some technologies of capacitor miniaturization, and describe desired properties of HiCV tantalum powder for miniaturization technology.

The iTSCi Programme: enabling tantalum supply from high risk areas by satisfying international expectations

by Kay Nimmo (ITRI Ltd), Karen Hayes (Pact Inc.) and Mickaël Daudin (Pact Inc.)
(presented by Kay Nimmo and Mickaël Daudin)

The iTSCi Programme has rapidly developed from a voluntary pilot project working in one area of the Democratic Republic of the Congo (DRC), to an industry standard for due diligence and traceability for the upstream '3T' sector of tantalum, tin and tungsten from three countries of the central African region to the international market. The Programme's unique and substantial success can be attributed to the effective combination of practical on-the-ground assistance for small scale operators and authorities in high risk areas, with understanding of market requirements and leadership in discussion of appropriate international policies.

The paper will recall the situation in central Africa in 2010 which drove negative 'conflict minerals' campaigns and led to regulations impacting the tantalum business, and track the positive transformation in the sector enabled through the continued progress and development of the iTSCi Programme in the 5 years since the Dodd-Frank Act was put in place. This will describe both the new business opportunities and available supply created by iTSCi as tantalum production from Africa has grown to a significant percentage of the world requirement, as well as the benefits resulting from that business engagement to the communities on the ground who now work in improved security and safety.

The paper will discuss links with the OECD and related expectations likely to be required by the upcoming EU Regulation on certification of imports of minerals and metals, our cooperation and harmonisation with the Conflict-Free Smelter Programme (CFSP), and current collaborative pilots with the World Bank on the Extractive Industry Transparency Initiative (EITI) for artisanal and small scale mining, and the Voluntary Principles on Security and Human Rights as the success of iTSCi leads to new opportunities to develop a sustainable industry.

Ultra-high capacitance powders using a Na flame process

by Steve Krause, John Koenitzer, Ashish Rai and Craig Sungail, Global Advanced Metals

New tantalum capacitors require greater charge density while achieving smaller footprints in new key applications. To enable the required performance, new process technologies are being developed that have the capability of producing tantalum powders with capacitance ranges of 200,000- 450,000 $\mu\text{FV/g}$. The Na flame synthesis process produces the required powder attributes to achieve this next level of performance. This paper will present a perspective of the powders being produced, the resulting electrical properties and discuss specific applications where they will likely find commercial use.

To source or not to source from the DRC, that is the question!

by Mike Loch, Responsible Trade LLC

The presentation will cover the issues and challenges of sourcing conflict minerals (defined as tin, tantalum, tungsten and gold) from the DRC. It will provide a downstream (brand company) perspective of the trials and tribulations of building the business case to allow minerals from the DRC and other conflict affected or high risk areas to be contained in the finished product, thus potentially increasing the company's risk and regulatory requirements. It will identify issues in the three levels of the supply chain from mine to smelter, the smelters themselves and finally downstream assurance from smelter to brand company. It will consider the in-region traceability schemes from iTSCi, Better Sourcing Program (BSP), BGR Certified Training Chain and the International Conference of the Great Lakes Region (ICGLR) Regional Certification Mechanism. Discussion will also include challenges a smelter faces as it begins to engage in the high risk area and how that is communicated via the Conflict Free Sourcing Initiative. Finally it will highlight concerns from downstream actors and the impacts it may have on continuity of supply, cost, brand reputation, shareholder value and regulatory compliance. Concrete examples of issues that have arisen while sourcing from the DRC will be presented along with impacts and outcomes of these challenges. Issues include taxation, smuggling, smelter Reasonable Country of Origin Information (RCOI) and Section 1502 Dodd-Frank compliance.

Tomtor niobium and rare earths deposit

by Alexander Malakh and Oleg Anikin, ThreeArc Mining

The Tomtor project is developed by ThreeArc Mining, a joint venture between ICT Group and Rostec. ICT Group is one of the largest private investment companies in Russia, while Rostec is a state corporation focused on technologies and fostering innovative development of the Russian economy.

The Tomtor niobium and rare earths deposit is located in the far north of Russia's Yakutia Province, roughly 300km from the Laptev Sea. It was discovered in the 1970s by Soviet geologists and has been studied rather rigorously up to the late 1990s. The deposit is characterized by enormous resources of niobium and rare earth metals. Geologically, the deposit represents a weathered carbonatite with very high niobium and REE content. The richest ores contain up to 15-20% Nb₂O₅, while the average Nb₂O₅ content is about 5.2%. All ore types found at Tomtor have over 10% TREO, mostly light rare earths and yttrium. The tantalum content in the ore does not exceed 0.11-0.12%.

The main challenge with Tomtor is logistics and harsh weather conditions, with winter temperatures reaching -60°C. ThreeArc Mining is planning to bring Tomtor on line by 2019-2020. The company is now developing the flowsheet for the hydrometallurgical processing of the ore. It is envisaged that the main niobium product will be standard grade ferroniobium.

EU Conflict Minerals Regulation (state of play)

by Signe Ratso, EU Commission, DG Trade

In March 2014, the European Commission adopted a draft Regulation setting up an EU system for supply chain due diligence of importers of tin, tantalum, tungsten and gold originating from conflict-affected and high-risk areas. In addition, a number of accompanying measures were adopted to promote the responsible sourcing of the minerals in the scope of the Regulation. In her contribution, Ms Ratso will present the European Commission's regulatory proposal and the progress made by the co-legislators, i.e. the European Parliament and Council under the Ordinary Legislative Procedure. She will highlight the importance of a coordinated international response on the responsible sourcing of conflict minerals along the lines established by the OECD. She will further elaborate on EU initiatives in support of due diligence of small and medium sized companies as well as of conflict regions setting up due diligence schemes.

Hermetically sealed low ESR, high reliability tantalum capacitors

by Jan Petržílek, Martin Biler, Jiří Navrátil and Miloslav Uher, AVX Corporation
(presented by William Millman)

Tantalum capacitors are passive components well known for their stability of parameters over a range of conditions. This makes them the best choice for special high reliability systems. Conditions can comprise high temperatures, humidity, mechanical shock and vibrations, thermal shocks and current surges. Over this range of operational conditions, high energy, low DCL and low ESR might be demanded. This article will discuss challenges and reliability evaluation of SMD hermetically sealed tantalum capacitors with conductive polymer cathode that are stable up to 150°C, can be rated up to 100V and exhibit super low DCL and single digit ESR.

Conflict-Free Sourcing Initiative: only one part of due diligence

by Leah Butler, Tara Holeman and Michael Rohwer, Conflict-Free Sourcing Initiative (CFSI)

The Conflict-Free Sourcing Initiative (CFSI) has experienced tremendous growth both in activity and in membership over the last year. However, the CFSI still has more work to do to help companies source 3TG responsibly. This presentation will cover an overview of CFSI's objectives and the tools and resources developed to improve companies' regulatory compliance and support legitimate sourcing from conflict-affected areas. The presentation will report on the progress to date and will summarize the current status and challenges. Then, the presentation will turn to suggesting a future state for the CFSP that takes a more holistic approach to validating companies' efforts to avoid contributing to conflict through their mineral sourcing practices via the OECD's Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (OECD Guidance). This holistic approach is intended to more closely match validation against the expectations laid out in the OECD Guidance specifically for upstream companies. Lastly, the presentation will address how we approach helping companies source responsibly from central Africa and other conflict-affected and high-risk areas to address the emerging EU regulatory framework.

Applications and properties of Metalysis FFC-produced spherical tantalum powder

by Ian Margerison, Kartik Rao and Ian Mellor, Metalysis Ltd

The presentation will demonstrate the applications of Metalysis FFC tantalum spherical powder with regards to SLM manufacturing. SLM is an additive manufacturing process by which a layer of tantalum powder is deposited onto a substrate and is spread uniformly by a wiper and then a high power density fibre laser fully melts the pre-deposited powder layer according to a specific computer generated two dimensional pattern. The melted particles fuse and solidify to form a layer of the tantalum component. The part retracts vertically and powder is deposited on top, the process is repeated until the three dimensional tantalum part is completed.

MEMBER COMPANY NEWS

EXOTECH

Exotech (Pompano Beach, Florida, U.S.A.) is pleased to announce the addition of Joel Nields to its sales team. His 10 years of experience with Ta, Nb, and V will complement Exotech's pre-existing business in these areas, as well as expand its suite of minor metals to include Hf, Zr, Re and their alloys. Exotech also specializes in Mo, W, Ti, In, Ge, Ni, Co, Cr and Ir scrap metals.

Exotech, a CFSI Certified Tantalum Smelter, is a major supplier of minor metals and high temperature alloys. In addition, it manufactures high purity Chromium Powder for the electronics and solar industries. Celebrating its 25th anniversary, Exotech will soon be opening a new ICP Laboratory (November 2015) and its third processing facility (Q1, 2016). This will expand its existing physical, thermal and chemical processing capabilities.

RESIGNATIONS AND TERMINATIONS

The following companies have resigned from the association: *GfE-MIR GmbH* and *Tosoh SMD, Inc.*

The memberships of the companies *ATL*, *Globe Metals & Mining Ltd* and *Rexwell Mining Co. Ltd* have been terminated by decision of the Executive Committee following non-payment of dues.

CHANGES IN COMPANY NAME

The following changes will be announced at the forthcoming General Assembly:

ABS Industrial Resources has changed name to **ELG Utica Alloys Ltd.**

Firadec has changed name to **Exxelia Tantalum.**

Specialty Metals Trading SA has changed name to **Specialty Metals Resources SA.**

Yichun Jinyang Rare Metals Co. Ltd has changed its English name to **Yichun Jinyang New Materials Co. Ltd.**

CHANGES IN MEMBER CONTACT DETAILS

Advanced Metallurgical Group N.V. (AMG)

Mr Fabiano Costa has become the delegate to the T.I.C. for Advanced Metallurgical Group N.V. (AMG), instead of Mr Hoy Frakes. His e-mail address is fcosta@amgmineracao.com.br.

BEH Minerals Sdn Bhd

BEH Minerals Sdn Bhd has announced a new e-mail address: behminerals@gmail.com.

Honeywell Specialty Chemicals Seelze GmbH

Honeywell Specialty Chemicals Seelze GmbH has nominated Mr Thomas Scholten as delegate to the T.I.C., in the place of Mr Mattis Gosmann. He can be reached on thomas.scholten@honeywell.com.

NEC Tokin Corporation

Mr Shinji Arai has become the delegate to the T.I.C. for NEC Tokin Corporation, in the place of Mr Masayuki Yamane. His e-mail is s-arai-sx@nec-tokin.com.

Tantec GmbH

Tantec GmbH has nominated Mr Georg Raab to represent the company within the T.I.C., in the place of Mr Olivier Lallement. He can be contacted on g.raab@tantec-group.com.

Tinco Investments Ltd

Tinco Investments Ltd has moved premises. Its new address is 26 Barrett Street, London W1U 1BG, England.

EXECUTIVE COMMITTEE

According to the Charter of the T.I.C., the Executive Committee may consist of between two and eleven people, plus the President. The Executive Committee is drawn from the membership, and committee members may be, but need not also be, the delegates of member companies.

The Executive Committee composition was approved by the T.I.C. members at the General Assembly on Monday October 13th 2014, and it currently consists of (in alphabetical order):

- Conor Broughton conor@amgroup.uk.com
- John Crawley jcrawley@mmc.com.hk
- David Gussack david@exotech.com
- Dale Gwinnutt dalegwinnutt@elitematerial.com
- David Henderson (President) dhenderson@rittenhouseir.com
- Marc Hüsspeler marc.hueppeler@hcstarck.com
- Jiang Bin jiangb_nniec@otic.com.cn
- Ian Margerison ian.margerison@metalysis.com
- William Millman bill.millman@avx.com
- Daniel Persico danielpersico-rc@nec-tokin.com
- Itamar Resende itamar.resende@mtaboca.com.br
- Alexey Tsorayev tsorayeva@ulba.kz

www.tanb.org
e-mail to
info@tanb.org