BULLETIN N° 143
ISSN 1019-2026

T.I.C.

TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Dear Friends,

As I write this, there are just four weeks remaining before we meet on the shores of Lake Tahoe for the Fifty-first General Assembly of the T.I.C. From the level of interest and pre-registration activity I am confident that once again we will have a lively, informative and relevant meeting, with what promises to be an excellent technical programme. Our thanks go to the authors and presenters of the technical papers for their hard work.

We would also like to thank Niotan Inc for sponsoring the Gala Dinner, and for laying on what will, I am sure, be an enjoyable site visit to the Niotan property and to the historic town of Virginia City. Thanks especially to Emma Wickens who is tireless in her efforts in assisting delegates with travel and visa arrangements, and in sorting out all the behind-the-scene details that make all the difference to the delegate's comfort.

While the market is returning towards a normal situation, primary production is now lagging behind, as several mines remain closed. The next couple of years could be exciting - but let us hope not a repeat of the 1999-2001 period. I await the paper on statistics with great interest!

Your various Working Groups continue to work hard behind the scenes. Our Technical Promotion Officer is ably representing the T.I.C. at several international forums related to Transportation, while several members are involved in various initiatives regarding the mining and trading of minerals in Central Africa. This is a difficult issue, and there will be a separate session at our forthcoming meeting to discuss these initiatives, and the T.I.C.'s ongoing position on them.

We look forward to seeing you at Lake Tahoe.

Richard Burt
President

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

CONTENTS

FIFTY-FIRST GENERAL ASSEMBLY AND TECHNICAL MEETING

The Fifty-first General Assembly meeting of the Tantalum-Niobium International Study Center will be held in Lake Tahoe, Nevada, U.S.A., from October 3rd to 6th 2010. The technical sessions and social events will take place at the Hyatt Regency in Incline Village.

On Sunday October 3rd, all participants are invited to a Welcome Reception from 6 to 8p.m.

The formal General Assembly of the association will be held on Monday October 4th and will be followed by technical presentations for the rest of the morning, then a buffet lunch.

On Monday evening, all participants are invited to a Gala Dinner, to be held in the elegant setting of the Lakeside Ballroom of the hotel.

A second technical session will be held on the morning of Tuesday October 5th, followed by lunch.

On Wednesday October 6th, there will be a plant tour to the facility of Niotan Inc in Mound House. After the plant tour, delegates will be given a guided tour of nearby Virginia City before taking lunch at Gold Hill hotel.

Sightseeing tours for those accompanying the delegates have been arranged. On Monday, participants will take a narrated bus tour around Lake Tahoe, stopping at various points of interest, including Thunderbird Lodge Estate, Emerald Bay and Squaw Valley. On Tuesday, they will continue to explore the scenic beauty of Lake Tahoe on board the MS Dixie II paddleboat. On Wednesday, they will take a narrated trolley ride through Virginia City, followed by lunch.

TECHNICAL PROGRAMME- ABSTRACTS

The following papers are expected (not in running order):

Hermetically sealed polymer tantalum capacitors

Y. Freeman, J. Chen, T. Kinard and S. Hussey - Kemet Electronics

Wet tantalum capacitors have been used in special electronics for a long period of time due to a combination of high working voltage (WV), high volumetric efficiency (CV/cc), and low d.c. leakage (DCL). There are several drawbacks which limit applications of these capacitors. They include high equivalent series resistance (ESR), especially at low temperature, and, related to that, capacitance roll-off with increasing frequency and reducing temperature. Wet capacitors also have

low tolerance to reverse voltage, re-formation delay, and catastrophic failure mode. In comparison to wet capacitors, polymer tantalum capacitors do not have these drawbacks; however, until recently their WV and CV/cc were much lower than those of wet capacitors, while the DCL was much higher than the DCL in tantalum wet capacitors.

Recent breakthroughs in tantalum capacitor technology and fundamental understanding of the conduction mechanisms in these capacitors allowed Kemet to develop a new type of hermetically sealed polymer tantalum capacitors. These capacitors are similar to the wet tantalum capacitors in terms of WV, CV/cc and DCL and can be used as a direct replacement of wet capacitors. At the same time, these capacitors have all the advantages of solid polymer capacitors, including low and stable-with-temperature ESR, capacitance which is stable with temperature and frequency, no re-formation delay, and forgiving failure mode. They also have record high breakdown voltage (BDV) at reverse voltage. The paper presents fundamentals and electrical characteristics of the new polymer tantalum capacitors in comparison to wet tantalum capacitors.

The use of tantalum based materials in industrial scale hydrogen production – a case study

Bo Gillesberg and Dean Gambale - Tantaline

With energy efficiencies exceeding 50%, the sulfur-iodine thermochemical process, developed by General Atomics, is among the most promising technologies for large scale future hydrogen production. Despite intensive research for decades, no materials with satisfactory corrosion resistance have been found among traditional corrosion alloys such as titanium and nickel alloys (Hastelloy). A pilot plant study made by General Atomics shows that tantalum based surface alloys developed by Tantaline are technically and economically attractive for an industrial scale-up of the hydrogen process.

This presentation will discuss the process conditions and the challenges faced in the sulfur-iodine thermochemical process and how Tantaline's tantalum based materials were used to meet the mechanical, chemical and economic challenges where virtually all other specialty materials such as nickel-based alloys, fluoro-polymers, glass, and tantalum metal have failed.

High CV/g tantalum flake powder from plasma spray technology

John Crawley - Niotan Inc

Limitations to the mechanical deformation of tantalum particles using conventional ball milling methods have prevented the attainment of tantalum flake particles capable of more than about 20 000 CV/g. A new and patented process developed by Niotan Inc using high speed deformation of ultra-high temperature tantalum promises to now go beyond this surface area barrier.

In this new process tantalum precursor powder is heated in a specially designed plasma torch situated in a controlled atmosphere chamber. The power level of the plasma torch is controlled to soften the tantalum particles to very close to the melting point while accelerating the particles to a selected speed sufficient to provide enough kinetic energy to just overcome the surface tension of the semi-molten tantalum metal, but not enough to shatter the particles.

Under these conditions the tantalum material, brought into this specific thermodynamic state, is impacted against a rotating, cryogenically cooled target of such geometry as to cause the immediate deformation of the tantalum to a very thin flake shape and freeze the shape before the residual surface tension forces can vitiate the morphology, thus preserving the flake shape in a solid particle. Unimpeded by the problems associated with the mechanical deformation of tantalum particles in the solid state a whole new category of surface area is opened up to the technology of tantalum flake.

The high volume production of tantalum flake using this method and the tantalum capacitor powder made from the flake is reviewed.

Progress with Nb_3Sn conductors for fusion and particle accelerator applications

Jeff Parrell and Scott Reiman - Oxford Superconducting Technology

The critical current density (Jc) of Nb_3Sn strand has been significantly improved over the last several years, through the development of internal tin processes. For many applications, high Jc internal tin strand has displaced strand made by the bronze process. However, for some applications high Jc alone is not sufficient. For fusion applications such as ITER, we have developed single-barrier internal tin strands having non-Cu Jc values over 1100 A/mm^2 (12 T, 4.2 K) with hysteresis losses less than 700 mJ/cm^3 over non-Cu volume. We will present early results from our production campaign for ITER. For high field magnet applications, higher Jc values are achieved using a distributed barrier design. We have continued development of high Jc strand made with Nb-47Ti rods to supply the dopant, and are working on optimization of the titanium content. This Nb-Ti strand maintains a Jc value of 3000 A/mm^2 (12 T, 4.2 K), but has improved higher field performance compared with our standard Nb-Ti material, reaching 1700 A/mm^2 at 15 T. To reduce the effective filament diameter in these high Jc strands, the number of subelement rods incorporated into the final restack billet has been increased to 127 in routine production, and results will be presented on experimental 217 stack billet configurations.

2010: a statistics and transport odyssey

Ulric Schwela - Tantalum-Niobium International Study Center

The T.I.C. statistics for the past five years have shown great changes for both niobium and tantalum. The industry has not been immune to the global economic downturn, with dramatic production cutbacks combined with fall in demand in 2008, followed by a gradual recovery beginning in 2009. The statistics review will cover all the T.I.C. statistics categories, i.e. niobium primary production and processors' shipments, tantalum primary production, processors' receipts and shipments, and finally capacitor producers' receipts. A reminder of the underlying principles will be provided.

The issue of Transport of Class 7 materials will be described separately, covering the highlights since 2003 and looking in greater detail at the major events of the past year. The aim remains to resolve the problems associated with the delay and denial of shipment of tantalum raw materials and the work is divided into distinct thematic areas: regulatory monitoring and participation in decision making at the International Atomic Energy Agency; tackling ongoing issues through the International Steering Committee on the Denial of Shipments of Radioactive Material where the T.I.C. now holds the position of Deputy Chair; direct assistance to members in resolving delays and denials as and when they occur.

How to make tantalum

James Fife - Niotan Inc

The chemical and physical processing we do in our factories to make capacitor grade tantalum powder is a tiny fraction of the job of actually making tantalum. The tantalum atom is composed of 73 positively charged protons crammed into a very small nucleus. The amount of energy required to assemble this atom from neutrons and protons against the mutual repulsion of these protons is amazingly large: one mole of tantalum (181 grams) would require the energy released by 25 000 tons of TNT to assemble! What process could have done this? The story of how tantalum is made is interesting, the answer perhaps surprising and the conclusions drawn from it are... tantalizing.

Production of superconductor niobium materials at TVEL Corporation

M.Y. Shlyakhov, V.V. Rozhdestvenskiy, V.I. Kalantyr and V.N. Kazantsev (JSC TVEL), K.M. Abramushin (JSC ChMP), A.E. Vorobieva and V.A. Drobishev (Bochvar Institut)

In 2008, at TVEL's subsidiary, JSC Chepetsky Mechanical Plant (ChMP), the new facility of low temperature superconductor (NbTi, Nb_3Sn) fabrication was put into operation. The facility includes large ingot production of Nb, NbTi alloy and tin bronze, fabrication of component parts (rods, tubes) and superconductor strands. Key advantages of ChMP are that the plant enjoys super modern equipment, a high safety and production culture, and a close relationship with the designer of the superconductor technology, Bochvar Institute (JSC VNIINM, Russia).

Russia plays one of the key roles in implementation of the International Thermonuclear Reactor (ITER) project. TVEL is nominated as the only Russian producer of superconductor strands for ITER; and large-scale production of superconductor materials was launched at the beginning of 2010. Other Russian participants in the ITER project are: Russian Research Center 'Kurchatov Institute' (ITER DA, Physics, Diagnostics, Engineering), Efremov Scientific Research Institute of Electrophysical Apparatus (Magnet systems, Divertor, Power supplies), Russian Cable Institute VNIIKP (Cable & Conductors).

A review of the main advances in superconducting strand technology is presented. Results of the main activities in research and development and those connected with ITER are outlined.

Tantalum sputtering targets: application, attributes and future

Paul S. Gilman - Praxair Electronics

In the 1970s an early application of tantalum sputtering targets was in the deployment of physical vapor deposition as the source material to deposit tantalum thin films for the fabrication of discrete thin film resistors. Since then the deposition of tantalum thin films has been integral to components in magnetic thin film heads and anti-cavitation layers in thermal inkjet printer heads. The exponential growth in tantalum thin film use can be correlated with the growth of copper metallization as the critical barrier layer in modern semiconductor devices. Today tantalum is the single most expensive material in a modern logic or memory chip. As semiconductor processing has become more sophisticated, the requirements of tantalum sputtering targets have become critical to achieving the proper thin film properties such as thickness uniformity, deposition rate and particle performance. Controlling the metallurgical characteristics of tantalum sputtering targets is essential as semiconductor geometries continue to shrink, in order to achieve high aspect ratio step coverage with conformal films while sputtering at a consistent deposition rate through target life. Examples of tantalum thin film depositions and their relationship to target properties will be given. Finally new opportunities for tantalum barrier applications in copper metallization for geometries ≤ 22nm, Through Silicon Vias and flat panel displays will be discussed.

Green manufacture of tantalum capacitor powder

Lee Ruch - Niotan Inc

Due to changing economic conditions and increasing environmental awareness global companies have become more concerned about environmental issues. Niotan is committed to minimizing the impacts on the environment associated with the manufacture of capacitor grade tantalum powder. Tantalum manufacturing requires consumption of alkali halide salts, sodium, magnesium, and mineral acids, and green manufacturing practice dictates diligence in optimizing use and recycling of raw materials as well as avoiding environmental damage from disposal of by-products. The advantage of building a manufacturing operation from green field allowed Niotan to avoid legacy problems, and from the beginning Niotan was able to engineer improvements in best available technology. The purpose of the paper is to analyze the environmental impact per coulomb of tantalum capacitor powder manufacture. Examples of Niotan's on-going efforts to improve 'greenness' of the process will be discussed.

Direct conversion of tantalum scrap to metallurgical and capacitor grade powder

Craig Hafner - Hi-Temp Specialty Metals

Hi-Temp Specialty Metals is always seeking to recycle all forms of tantalum to its highest value form with the lowest cost and environmental impact. This presentation details the company's current progress towards the direct conversion of various forms of scrap to tantalum powder. Specifically, the methods of identifying useable starting material, techniques to remove deleterious impurities and convert to powder, and the properties of the powders produced will be discussed.

Special session: Working Group on Tantalum and Niobium Mining

Order out of chaos: ongoing developments with the Supply Chain initiative

Richard Burt - GraviTa, and William Millman - AVX

The T.I.C. Artisanal and Small Scale Mining Policy was ratified by the membership at the Fiftieth General Assembly in Tallinn, and a subsequent presentation provided a road-map for its implementation. Since the meeting in Tallinn the issue of mining and trading of minerals from countries of weak governance has received considerable attention from various bodies, including the United Nations, the OECD, the International Conference on the Great Lakes Region (ICGLR), the governments of Germany and the U.S. among others, the tin industry, and tantalum's major end-users the electronics and telecommunications industries. This paper will provide the membership with an update on these various initiatives, the role that the T.I.C. has been playing in shaping the conclusions and our efforts to bring 'order out of chaos' in the tantalum supply chain from central Africa with our support of the iTSCi pilot project under way in the eastern Democratic Republic of Congo.

Status report on the iTSCi project in eastern DRC

Karen Hayes - Pact

The presentation will give an up-to-the-minute report on progress in implementing the iTSCi project in South and North Kivu in eastern DRC. Pact is a strategic advisory partner to ITRI in this project and works directly on the ground with the local implementing organizations, artisanal miners, buyers, government representatives and the security services to assist all actors to understand and play their roles in ensuring traceability of minerals from mines to the point of export from the DRC. The presentation will discuss the practical challenges encountered and the solutions that have been developed, along with an analysis of the future of the initiative within the rapidly changing political and economic situation in the region. The presentation will also look at how the iTSCi project presents an important opportunity to trial the OECD Due Diligence Guidelines at ground level, specifically looking at the standards relating to working conditions in artisanal mines and engagement of 'conflict' actors.

OEM requirements for responsible sourcing in the metals Supply Chain

Jerry Meyers – Intel Corporation

The electronics industry takes very seriously the allegations that metals (gold, tantalum, tin and tungsten) mined in the Democratic Republic of the Congo (DRC) might be used in the electronics supply chain, and that profits from the sale of these metals may be fuelling human rights atrocities in the eastern region of the DRC.

The issue of extractives from the DRC used in the electronics and other industries is extremely complex, and resolution will require the commitment and cooperation of businesses, governments, development agencies, and non-governmental organizations (NGOs).

The Electronics Industry Citizenship Coalition (EICC) and the Global e-Sustainability Initiative (GeSI) have come together to identify a process for tracing these four metals through the supply chain. After analyzing the supply chain in the electronics industry the optimal point was found to be the ore processors (or smelters). The process for verification of the origin of the materials will be reviewed.

MEMBER COMPANY NEWS

Exotech expands processing facility

Exotech has purchased a 25,000 sq. foot (2300 sq. meter) building next to its existing facility in order to expand its processing operation and increase its processing capability. The new building will double Exotech's operating plant. Overall the two properties will occupy 2.6 acres.

New and enhanced operations will include chemical, thermal, and physical processing. The new facility is expected to be operational by the end of 2010.

Exotech is a processor of secondary high value metals with particular emphasis on the recycling of sputter targets. Key metals are tantalum, niobium, cobalt, tungsten, molybdenum, indium, and chromium. Exotech also produces high purity chromium powder for the sputter target industry to customer size and purity specifications.

Changes in member contact details

Camet Metallurgy

Camet Metallurgy has a new address: 1693 St-Patrick Street, Montreal QC, Canada H3K 3G9. Telephone and fax numbers remain unchanged.

Elite Material Solutions

The offices of Elite Material Solutions have moved. New contact details are as follows.

Address: 17 Hayman Rise, Grange Farm, Milton Keynes, Buckinghamshire MK8 0ND, England
Tel.: +44 1908 506819
Fax: +44 1908 502582

Fogang Jiata Metals

Please note the following contact details for Fogang Jiata Metals.
Tel: +86 20 38063586 and +86 20 38063528
Fax: +86 20 38063558
Website: www.jycmetal.com

Mac Corporation

Mr Kentaro Tonami has been promoted to the position of President of Mac Corporation. He becomes the delegate for this company. E-mail: k.tonami@mac-corp.net

NEC Tokin Corporation

NEC Tokin Corporation has nominated Mr Masayuki Yamane as new delegate to the T.I.C.

Rexwell Mining Co

Please note the following contact details for Rexwell Mining Co.
Tel.: +255 22 2124987 and +255 764 601018
E-mail: rexwelltz@gmail.com and rte09@mail.ru

Thailand Smelting & Refining Co

Following the retirement of Mr Spratt, Mr Nicholas Thorne has been nominated as delegate to the T.I.C. for Thailand Smelting & Refining Co. His e-mail is nick.thorne@thaisarco.com.