BULLETIN N° 139
ISSN 1019-2026

T.I.C.

TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Dear Friends,

Very soon we shall meet in Tallinn, Estonia, and I am confident that we shall have another successful event, which will be the Fiftieth General Assembly and mark the thirty-fifth anniversary of the foundation of the T.I.C. Yes, it was way back in 1974 that the association was set up in Brussels and held its first Assembly.

Our choice of Tallinn, the charming and historic capital of Estonia, reflects the invitation of Silmet to visit the company's plant at Sillamäe. We welcome warmly the opportunity to tour this facility, and thank Silmet for the exciting proposal of a medieval banquet lunch in a castle as a celebration of this special Assembly.

About 150 delegates and 20 persons accompanying them are expected to come to the meeting, a very good attendance in this time of economic difficulties. Another excellent and wide-ranging programme of technical papers has been arranged, and I should like to thank all the authors and presenters.

My year as President has flown by and comes to an end with this meeting, and I am grateful to my colleagues on the Executive Committee and to the staff for all their support and co-operation.

Every year the visa regulations become more complex, and helping delegates to obtain the necessary documents to travel to meetings has become a major task. Our Secretary General undertakes this, and also the planning of the event and reservations of hotel rooms, in addition to her duties of administration of the T.I.C. throughout the year. I express appreciation, on behalf of everyone involved in the association, to Emma Wickens for all her continuing hard work.

I am sure we are all looking forward to our meeting in Tallinn.

José Isildo de Vargas
President

CONTENTS

FIFTIETH GENERAL ASSEMBLY AND TECHNICAL MEETING

The Fiftieth General Assembly meeting of the Tantalum-Niobium International Study Center will be held in Tallinn, Estonia, from October 18th to 21st 2009. The technical sessions and social events will take place at the Swissôtel.

On Sunday October 18th, all participants are invited to a Welcome Reception from 6p.m. to 8p.m.

The formal General Assembly of the association will be held on Monday October 19th and will be followed by technical presentations for the rest of the morning, then lunch. On Monday evening, all participants are invited to a Gala Dinner, to be held at the hotel.

A second technical session will be held on the morning of Tuesday October 20th, followed by lunch.

On Wednesday October 21st, there will be a plant tour to the facility of AS Silmet in Sillamäe. After the plant tour, delegates will be the honored guests of Silmet to a medieval lunch in Rakvere castle.

Sightseeing tours for those accompanying the delegates have been arranged.

TECHNICAL PROGRAMME-ABSTRACTS

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

Tantalum – a rare metal in abundance?
Richard Burt - GraviTa Inc.

Tantalum is classified as a rare metal. How rare *is* it? Is it really in short supply or is there enough for the foreseeable future?

This paper will be one person's view as to the abundance – or lack thereof – of potential future tantalum supply and it will attempt to shed some light on the often confusing information that is published in the technical and popular press. The paper will take a holistic approach: rather than concentrating on a few well known deposits it will attempt to collate information on as many deposits as possible. It will discuss and differentiate between geologic occurrences, resources and reserves, and the increasing level of information that becomes available – not only geological information, but mineralogical, metallurgical and cost information.

By weighting the various data, a regional, statistical, 'most likely' resource base has been developed, giving an overall indication of potential future supply.

Flux pulling method of growing stoichiometric $LiTaO_3$ crystals
Li Bin and Zhang Xuefeng - Ningxia Orient Tantalum Industry Co., Ltd

Near stoichiometric $LiTaO_3$ crystals were grown by the flux pulling method from a congruent melt by adding K_2O. The analysis of the spectroscopic properties and Curie temperature of these crystals indicates that, compared with the congruent $LiTaO_3$, the ultraviolet absorption edges shift towards a shorter wavelength, also the Curie temperature increases. When the quantity of flux is 17mol% K_2O, the size of crystal is about 50×50mm, the Curie temperature of head is 678°C, the Curie temperature of tail is 681°C, and the ultraviolet absorption edge is 261nm. From these experimental results the content of Li_2O is estimated to be about 49.9mol%. Therefore, flux pulling can be regarded as a suitable method for growing stoichiometric $LiTaO_3$.

Accelerating science – the Large Hadron Collider at CERN
James Gillies - CERN

At 27 kilometres in circumference, colder than outer space, and containing enough superconducting filament to reach to the sun and back five times, the LHC is a machine of superlatives. It is mankind's most ambitious scientific experiment, bringing together scientists from some 500 universities around the world, and it is set to change our view of the universe. Over recent decades, the fields of particle physics and cosmology have made huge advances in mapping the universe from its tiniest constituents to its vastest expanses. Particle physics has given us the standard model, a sort of periodic table of the fundamental particles and their interactions. The standard model provides an extraordinarily precise picture of the particle world, but it is incomplete. Part of the evidence for this comes from the science of the very large. By observing the universe at the largest distance scales, scientists have found that visible matter, as described by the standard model, makes up only about 4% of the total mass and energy of the universe. The rest is enigmatically called dark matter and energy. Starting to explore the remaining 96% is among the goals of experiments at the LHC. This talk will describe the LHC project and its host laboratory, CERN, and give an overview of the exciting science the LHC is poised to deliver.

Ultra76 – a new tantalum alloy for the chemical process industry
Paul Aimone - H.C. Starck Inc.

Tantalum and tantalum alloys have been extensively used in electronic, chemical processing, and other industries for many years. Alloying tantalum with tungsten improves mechanical strength as well as increasing corrosion and hydrogen embrittlement resistance without degrading the other physical properties of pure tantalum. The outstanding corrosion resistance of tantalum and tantalum alloys is attributed to a very thin, protective tantalum pentoxide (Ta_2O_5) film that forms upon exposure of the metal to oxidising conditions. Only when the oxide film reacts with or is penetrated by a chemical reagent does corrosive attack occur on the underlying metal. Industrial experience has repeatedly shown that even when this attack occurs, hydrogen embrittlement rather than corrosion is the predominant failure mechanism for tantalum materials. H.C. Starck undertook development of a new tantalum alloy with improved corrosion and hydrogen embrittlement resistance. Test results have shown this derivative of the Ta-3W alloy (NRC®76) has corrosion and hydrogen embrittlement rates that are one to two orders of magnitude lower than conventional Ta-3W alloy in hydrochloric acid and five to ten times lower in sulfuric acid, with comparable mechanical properties.

Statistics and transport
Ulric Schwela - T.I.C.

The latest T.I.C. statistics are compared with those for the previous five years, for the categories of niobium primary production and processors' shipments, tantalum primary production, processors' receipts and shipments, and finally capacitor producers' receipts. A reminder of the underlying principles is provided.

The activities of the Transport Committee are described as it continues its work to resolve the problems associated with the delay and denial of shipment of tantalum raw materials. This involves participation in regulatory developments, the International Steering Committee on the Denial of Shipments of Radioactive Material plus regional activities and the development of a Communication Campaign.

Environmental compliance and waste minimisation in tantalum scrap metal recycling
Craig Hafner - Hi-Temp Specialty Metals

This presentation looks at the regulatory environment of environmental regulations both in the U.S. and worldwide, and the current status of tantalum recycling efforts. Hi-Temp employs various techniques to minimise its environmental impact and maintain regulatory compliance, while maximising the value of the recycled tantalum. Hi-Temp's methods of processing tantalum scrap to its highest form while minimising the environmental impact will be discussed.

Further development of the high temperature processing concept for niobium-microalloyed API pipe grades
Volker Flaxa - Salzgitter Mannesmann Forschung GmbH

The Salzgitter Group has a cluster of several subsidiaries in the state of Lower Saxony, Northern Germany. Hot wide strip is being produced on the modernised hot strip mill of Salzgitter Flachstahl GmbH. High quality spiral pipes are subsequently produced at Salzgitter Grossrohre GmbH using submerged arc welding. Future alloy designs and processing routes for spiral pipe grades are developed at Salzgitter Mannesmann Forschung GmbH.

Hot-rolled wide strip for production of large diameter, heavy gauge (up to 19 mm) helical line pipe grade X80 was a priority development over the last three years. Microstructure, texture and mechanical properties of strips have been characterised. Also the welding conditions have been simulated. The favourable microstructure is achieved by the proper selection of an appropriate chemical composition of low carbon content and increased niobium microalloying in combination with

suitable strictly controlled hot rolling parameters. The addition of niobium in combination with the adjustment of other alloying elements increases the recrystallisation stop temperature and thus makes it possible to apply a high temperature processing (HTP) concept.

A homogeneous acicular ferritic microstructure across the strip gauge is then formed during accelerated cooling on the run-out table of the hot rolling mill. All results indicated excellent properties of this hot strip making it suitable for spiral pipes of grade X80.

Mibra mine: a long-term reliable source of tantalum from Brazil
Itamar Resende - Cia. Industrial Fluminense

Mibra mine has just completed an expansion process to produce 300000 lbs of Ta_2O_5 concentrate per year, associated with an estimated reserve of over 30 years. Most recent exploratory work has indicated that reserves may be larger and the company is considering further expansion in the future. In this paper we will review the Mibra business model which is based on multi-product approach, sustainability, respect for the environment and cost competitivity.

Cambridge FFC process environmental, commercial and scale-up considerations
Ian Margerison, Ian Mellor and Lee Shaw - Metalysis

The presentation will highlight the advancements made since the discovery of the process at Cambridge University in 1997, to being on the cusp of commercialisation in 2009, with particular reference to the production of tantalum.

The basis of the FFC Cambridge process is the electrochemical reduction of an oxide (cathode), realised by applying a potential between this and a counter electrode (anode), resulting in the metal product remaining at the former, and the evolution of gaseous oxygen containing species at the latter. This is performed in a molten fused salt (calcium chloride) electrolyte in the region of 800 to 1000°C.

The elegance and simplicity of the FFC process is that the morphology and characteristics of the ensuing tantalum can be tailored through the careful choice of the electrolysis parameters.

The FFC process compares favourably to the more common sodium reduction route in terms of energy efficiency and is more environmentally benign, the only by-products being carbon monoxide, carbon dioxide and calcium chloride (road salt).

The tantalum supply chain – discovery and exploration to production and how to maintain security of supply
David Hodge - Commerce Resources Corp.

Exploration companies provide an important first step in the tantalum supply chain by identifying new sources of tantalum and defining their economic significance. By supplying a pipeline of virgin properties to be evaluated, they play an important role in securing and supporting a robust tantalum supply chain. As these companies continue to explore and advance their projects into development, and ultimately into production, the specifics of how they operate will change, but their ongoing activities remain critical to the maintenance of the chain. This talk will consider the diverse and varied roles of exploration companies in supporting a secure supply of tantalum, as well as the needs for multi-talented (and sometimes completely different) management teams at various stages in evaluating and advancing their projects. It will also look at industry needs for support and partnership through the various phases of development to ensure a safe and conflict-free global supply of tantalum for the longer term.

Application of niobium based superconductors in Magnetic Resonance Imaging systems
Jonathan Noys and Adrian Thomas - Siemens Magnet Technology

Niobium-titanium is the primary alloy used in the manufacture of superconducting magnets for Magnetic Resonance Imaging (MRI) systems. This paper will present the basic operational principles of an MRI system, and the requirement which these principles make for a high strength, high stability homogeneous magnetic field. The physical restrictions which mean that these requirements can only be met through the use of superconductors, and why the niobium-titanium alloy has remained the dominant material for this role through 25 years of continual growth in the MRI market, will be discussed.

The paper will present some of the engineering challenges which result from the requirements of the imaging system, and the technology used to satisfy them.

Recent advances in tantalum and niobium capacitor technologies
William Millman, Stanislav Zednicek and Tomas Zednicek - AVX Limited, Tantalum Division

Future growth in tantalum and niobium capacitors will be based upon their ability to adapt and to survive the real world demands of the electronic industry. The rapid growth of the electronics industry requires improved functionality, greater portability, lower power consumption, higher reliability and smaller less costly solutions to – sometimes very complex – challenges. To paraphrase, they need to be 'better, faster, cheaper'.

The growth in demand over the last decade for solid electrolytic capacitors stands in stark contrast to that of MLCC types. If tantalum and niobium capacitors are to remain a significant player within the family of capacitor dielectrics they must evolve and provide compelling solutions.

ROSKILL: 'THE ECONOMICS OF TANTALUM'

Roskill Information Services has announced in September 2009 the publication of an update of 'The Economics of Tantalum' (10th edition). More information on the contents can be viewed on www.roskill.com/reports/tantalum. The document can be purchased from Roskill in hard copy or in electronic format.

MEMBER COMPANY NEWS

Rod Tolley

The Tantalum-Niobium International Study Center was very sad to learn that Roderick Tolley passed away on April 10th 2009, at the age of 82. Rod Tolley had a long and distinguished career in the mining and metals industry and was well respected for his wide knowledge in this field.

He was a member of the T.I.C. Executive Committee from May 1983 to April 1988, as the representative of Datuk Keramat Smelting, part of Amalgamated Metals Corporation (AMC), and served as President for the year from October 1986. He was very active in the organisation of the meeting in Penang in 1983, with a plant tour of the smelting facilities of his company.

Following his retirement from AMC, Rod Tolley was appointed as the T.I.C.'s Technical Adviser and remained in this capacity from October 1989 to October 1993, working on the statistics collection, industry surveys and the quarterly Bulletin, and responding to inquiries. He also wrote articles and papers which he presented to other organisations as well as association meetings, and prepared displays for several exhibitions, where he then represented the T.I.C., to promote tantalum and niobium.

Mark Wassweiler

Mark Wassweiler, of Wasser LLC, passed away in June, the Tantalum-Niobium International Study Center learned with great regret.

He first attended a T.I.C. meeting in 1998, when he was investigating the possibility of re-opening a tantalum deposit on family land in his home state of Alabama. After several years of careful consideration, his plans advanced and he came back to the association; his company duly joined in 2006.

With his colleagues, Mark Wassweiler took part fully in meetings of the T.I.C., and he will be remembered for his quiet good humour and his friendly personality.

Michael Herzfeld

The Tantalum-Niobium International Study Center was very sorry to hear of the passing of Michael Herzfeld at the age of 82. Michael died peacefully in his sleep on August 31st.

He had been a very active member of the T.I.C. ever since its foundation in 1974. At that time, he was the delegate for Hochmetals Africa, one of the twelve founder members of the association. Over the years, he represented several member companies, such as Datuk Keramat Smelting, Makeri Smelting, Somirwa, Zairetain and Sominki.

From 1996 to 2007, Michael Herzfeld was a member of the Executive Committee, when he was the delegate of A&M Minerals and Metals.

Michael was still very actively carrying out business on behalf of A&M, backed by his extensive knowledge of the industry and the people involved. He rarely missed a gathering of the T.I.C., and had been looking forward to seeing everyone in Tallinn in October.

Wasser LLC

Wasser LLC is looking for buyers interested in its McAllister tantalum deposit located in Coosa County, Alabama, U.S.A. Potential buyers should contact Michelle Wassweiler at michellewssw@aol.com, or by telephone on +1 334 220 9736. Technical details can be obtained by contacting Dr Robert Cook (cookrob@auburn.edu), who is advising Mrs Wassweiler on the mining side. Wasser LLC purchased the property in 1994 with the intention of developing it into a mine; due to personal reasons the owners are no longer able to continue work on this project.

A prospectus was provided by the company at the 47th General Assembly meeting in Innsbruck in 2006, including a description of the local and regional geologies and ore analyses. The prospectus describes the McAllister deposit as containing an estimated 1.2 Mlb Ta_2O_5 with the prospect of further deposits in the region. The deposit is a pegmatite dyke approximately 450 m long and up to 40 m thick, with pipe-like zones up to 7.6 m in diameter containing disseminated wodginite. Grades within these pipes range up to 1% Ta_2O_5 over narrow intervals, while the overall deposit grade is around 700 ppm. The deposit was mined briefly by the company O'Dell in the early 1990s.

Changes in member contact details

Conghua Tantalum & Niobium Smelter

The contact details for Conghua Tantalum & Niobium Smelter have been updated. Please note the following:
Address: Chicao, Shen'gang, Taiping Town, Conghua, Guangdong Province, 510980, China.
Tel.: +86 20 8780 7891, Fax: +86 20 8780 7290
E-mail: ctns@21cn.com, website: www.ctns723.com

DM Chemi Met

The office of DM Chemi Met Ltd has recently moved. Here are the new contact details:
Address: Venturers House, King Street, Bristol BS1 4PB, England.
Tel.: +44 117 915 4023, Fax: +44 117 915 4383
The delegate remains Ms Daisy Xie, and the e-mail address is unchanged (daisy@dmchemimet.co.uk).

Gui-Family Tantalum-Niobium

The e-mail address and website of Gui-Family Tantalum-Niobium have been changed to the following:
E-mail: tanb@king-tan.com, website: www.king-tan.com

Jiujiang Tanbre Smelter

Jiujiang Tanbre Smelter has nominated a new delegate to the T.I.C.: Mr Guo Yongzhong replaces Mr Yuan Yuanming, who has left the company.

MTU Aero Engines GmbH

Mr Robert Winter has been nominated as the delegate of MTU Aero Engines. Contact details are:
E-mail: robert.winter@mtu.de
Tel.: +49 89 1489 6966, Fax: +49 89 1489 96421