

# T.I.C.

## TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

### PRESIDENT'S LETTER

Dear Friends,

The clock is ticking quickly with approximately four weeks left till we meet in Shanghai for the Forty-ninth General Assembly of the T.I.C.

We expect high numbers of participants, with 200 delegates registered so far and another 25 accompanying persons.

We would like to thank our sponsors, Kemet Electronics Corporation and Ningxia Non-ferrous Metals Smelter, who have promised to make this a most productive and memorable meeting. Many thanks also to the presenters and authors of the Technical Papers which will prove to be most enlightening and interesting for all the attendees.

The diligent and round-the-clock work by Emma Wickens in assisting participants with travel and visa arrangements has also been greatly appreciated.

This will prove to be my final letter as President and my last meeting on the Executive Committee. I wish to thank warmly the members of the T.I.C., the Executive Committee, the Technical Promotion Officer and the Secretary General for all their guidance and help over the years.

We look forward to seeing you in Shanghai.

William Young, President

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**Please note our new office address:**

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The T.I.C. is an 'association internationale' under Belgian law.

### FORTY-NINTH GENERAL ASSEMBLY AND TECHNICAL MEETING

The Forty-ninth General Assembly meeting of the Tantalum-Niobium International Study Center will be held in Shanghai, China, from October 19th to 22nd 2008. The technical sessions and social events will take place at the Westin Bund Center Hotel.

The formal General Assembly of the association will be held on Monday October 20th and will be followed by technical presentations. A second technical session will be held on the morning of Tuesday October 21st.

On Wednesday October 22nd, there will be a plant tour to the facility of Kemet Electronics in Suzhou.

The programme for the meeting will be completed by a welcome reception on the evening of Sunday October 19th, and a gala dinner on the evening of Monday October 20th, hosted jointly by Kemet Electronics Corporation and Ningxia Non-ferrous Metals Smelter. There will also be sightseeing tours for those accompanying the delegates.

### TECHNICAL PROGRAMME - ABSTRACTS

**The actuality and future development of China's superconductive niobium materials**

*by He Jilin, Zhong Jingming, Chen Lin and Xie Weiping, Ningxia Orient Non-ferrous Metals Group*

Micro-wave superconductive cavities and accelerator fabricated from metallic niobium have high accelerating field intensity, low energy-dispersion properties and long life due to the excellent superconductivity and thermal conductivity of the metal, so metallic niobium has become the most suitable metal for fabricating superconductive accelerating resonance cavities. With the development of high energy techniques in physics and the continuous improvement of superconductive accelerating cavities' accelerating gradient, requirements have increased for pure niobium material for superconductive usage and its fabricating techniques. In recent years, there has been a great development in the China niobium industry in metallurgy, refining and processing. Ningxia Orient Non-ferrous Metals Group Company (NONMG) has continuously upgraded niobium products by promoting technical innovation and improvement in the aluminothermic reduction process for fabricating metallic niobium, and in the melting techniques of a 600KW electron-beam furnace and related equipment. The purity of niobium products has been enhanced continuously, and the contents of impurities such as O, N, C and H in the niobium ingots are lower than 10ppm. RRR of niobium slice with coarse particles can be 587 at most. The RRR value of rolling superconductive niobium material has been upgraded from around 50 at the beginning to more than 300. Ningxia Orient Non-ferrous Metals Group Company has already been equipped with some capability in producing superconductive niobium material, and has provided products to engineering projects worldwide. Ningxia Orient

Non-ferrous Metals Group Company intends to continue its innovation in superconductive niobium materials.

### **Tantalum sputtering target performance**

by John Koenitzer, James Maguire, Lisa Maiocco and David Field, Cabot Supermetals

Performance of tantalum in sputtering applications is affected by its metallographic texture. In this paper, we will compare the effects of two different textures on the sputtering performance of hollow-cathode sputtering targets. The tantalum deposition rates and resultant film thicknesses will be correlated to the sputtering target texture as measured by EBSD (Electron back-scattered diffraction).

### **Fingerprinting the origin of tantalum ores**

by Frank Melcher, Torsten Graupner, Maria Sitnikova and Thomas Oberthür, German Federal Institute for Geosciences and Natural Resources (BGR)

Following the United Nations' proposal to fingerprint the origin of raw materials and in line with the German G8 initiative on increased transparency of the world markets, our working group at the BGR has embarked on a project to fingerprint the origin of tantalum ores. The study is funded by the German Ministry for Economic Cooperation and Development and the Ministry of Economics and Technology.

Since 2006, our working group has been investigating tantalum ores, mainly columbite-tantalite mineralization. So far, more than 400 samples have been obtained from the world's major tantalum producing areas. Special attention is, however, directed to samples and concentrates from the Ta-Nb-Sn provinces in Africa – DR Congo, Rwanda, Mozambique, Ethiopia, Nigeria and Namibia. We have added mineralogical state-of-the-art analytical tools to the chemical and physical methods usually employed in forensic science. Methods used in a step-wise manner include ore microscopy, Mineral Liberation Analysis (MLA), electron microprobe analysis, laser ablation plasma-source mass spectrometry, X-ray fluorescence spectroscopy, X-ray diffraction analysis and thermal-ionization mass-spectrometry.

Distinction between columbite-tantalite ores and concentrates from different deposits is achieved by the establishment of (1) mineral assemblages in the ore concentrates, (2) major and trace element concentration patterns (e.g. REE) in columbite-tantalite crystals, (3) geochronological analysis (U/Pb isotopes), and (4) subsequent data treatment using multivariate statistics. For example, certain mineral assemblages are distinct for columbite-tantalite ores from Mozambique or Ethiopia, and regional age populations are evident in Africa: Archaean (>2.6 Ga), Paleoproterozoic (1.9-2.1 Ga), early Neoproterozoic ("Kibaran" - 0.98-0.93 Ga), and late Neoproterozoic to early Palaeozoic ("Pan-African" - ca. 0.5 Ga).

Currently, we are focussing on the resolution of the fingerprinting system on a scale ranging from the region via the ore province down to the deposit. Examples of our analytical procedures and flow sheets developed for the identification of sources will be presented. Our analytical results so far indicate that a certification scheme including fingerprinting of sources of columbite-tantalite ores is technically feasible.

### **Don't be a statistic, report statistics!**

by Ulric Schwela, Technical Promotion Officer, Tantalum-Niobium International Study Center

Collection and reporting of T.I.C. Statistics is a cornerstone of the association's *raison d'être*; yet this can not happen without the timely cooperation of the member companies. Companies that repeatedly delay reporting create a disservice to the entire niobium and tantalum industry. The Executive Committee is advised of those companies that are persistently late; now it is these companies that become the statistics! The message is clear: 'Don't become a statistic, report on time and encourage your fellow members to report on time for everybody's benefit'. The underlying principles and material flows involved in the T.I.C. industry statistics will be illustrated, followed by an overview of the past five years' statistics covering niobium primary production and processors' shipments, tantalum primary production,

processors' receipts and shipments, and finally capacitor producers' receipts.

A summary of the Transport Committee's activities will show the continuing efforts made to resolve the problems associated with the delay and denial of shipment of tantalum raw materials. Particular focus will be given to the work carried out by the International Steering Committee on the Denial of Shipments of Radioactive Material, the workshops organised, the regional networks and early indications from the database. Finally, the participants in the tantalum industry will be reminded that in order for progress to be made, they must report their instances of delay and denial.

### **Tantalum supply - back to the future**

by David Henderson, Rittenhouse International Resources, LLC

Ten years ago, some were predicting that the majority of tantalum supply in the future would come from hard rock pegmatite mining. In contrast, we now believe the importance of tantalum from by-product deposits will continue to grow. The author will review current supply from primary production and secondary sources and then evaluate these and near term prospects relative to demand trends.

### **Niobium - the capacity expansion project at CBMM**

by Clóvis Antonio de Faria Sousa, Companhia Brasileira de Metalurgia e Mineração (CBMM)

The niobium market is facing a strong increase in demand since the beginning of this decade, mainly in ferro-niobium for steel applications.

CBMM, as major supplier, is committed to guaranteeing the availability of the metal for the whole market. To cope with this, a comprehensive plan of expansion is in course.

This paper describes the plan for production capacity expansion in CBMM Araxá's plant. The expansion is divided into two phases. The first will be effective by the end of 2008 increasing the ferro-niobium STD production capacity to 90 000 ton/year, and the second will be finalized at the end of 2013, reaching 150 000 ton/year capacity.

The paper also outlines the reasons for the recent increase in the demand for niobium.

CBMM's production strategy for the future is also briefly described.

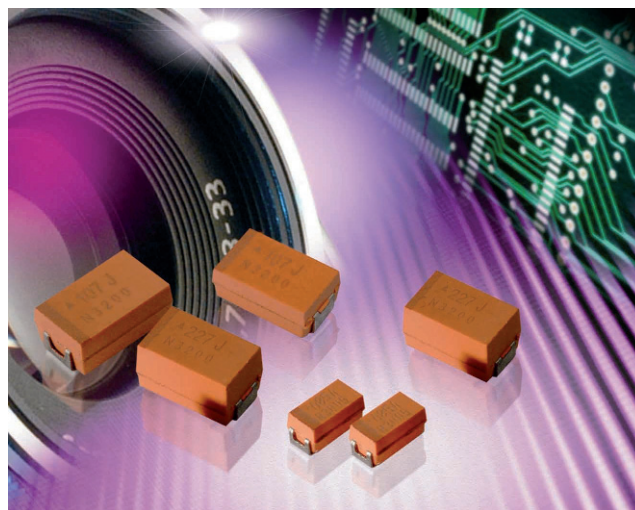
### **Counterfeit passive components – a growth industry!**

by W.A. Millman, AVX Limited

Caveat Emptor – never has this been more appropriate.

Popularly associated with high value fashion or 'designer' items such as watches, jewellery, perfumes, clothing, handbags, and sun glasses. Often seen as a 'bit of fun' and a 'victimless crime'. We have even developed a language to disguise the activity for what it really is – a crime. Theft and much worse.

Counterfeit electronic passive components within the mainstream electronics supply network was never considered serious or likely. But things change.



### Applications of niobium in superconducting materials

by Xianghong Liu, Western Superconducting Technologies Co., Ltd.

Niobium becomes a superconductor when lowered to cryogenic temperatures. At atmospheric pressure, it has the highest critical temperature of the elemental superconductors: 9.3 K. Niobium has the largest magnetic penetration depth of any element and it has become the primary material used in superconducting applications.

Niobium-tin and niobium-titanium alloys are used as wires for superconducting magnets capable of producing exceedingly strong magnetic fields. Niobium is also used in its pure form to make superconducting accelerating structures for particle accelerators.

This paper describes the superconducting applications of niobium, and the progress of niobium in superconducting materials.

### Highest capacitance tantalum powders: a challenge!

by H. Haas, C. Schnitter, N. Sato, H. Karabulut, Y. Fujimori and O. Thomas, H.C. Starck GmbH and H.C. Starck Ltd.

In order to meet the challenge of the electronic industry to further miniaturise electronic devices, especially for mobile phone applications, tantalum capacitors have to provide higher and higher volumetric efficiencies.

To fulfil this demand, tantalum producers have to develop powders with surface areas exceeding 4.5m<sup>2</sup>/g – the highest surface area of powder available in the market today. Conventional production processes are at their limits, either from the viewpoint of quality or that of economics.

The magnesium reduction process of tantalum oxides has been developed to overcome these limits. The process can provide surface areas of >10 m<sup>2</sup>/g – designed for the next generations of tantalum capacitors.

This process has been now investigated in more detail to get a better understanding of the reaction mechanism. We will report on these investigations, showing the possibility of creating nano sized tantalum particles, providing extremely high surface areas. We will also discuss the challenges of producing, testing and using these high surface area powders. Either producers or users will have to modify their processes from those used with traditional powders in order to use these extremely high surface area tantalum powders.

### A new method for quantification of texture uniformity of plate

by Peter Jepson, H.C. Starck Inc and Robert Bailey, Tosoh SMD

Since grains of different orientations sputter at different rates (in tantalum, a fast-sputtering orientation sputters at about twice the rate of a slow-sputtering orientation), control of texture in plate for sputtering targets is very important, particularly when the film to be deposited must be of very uniform thickness. In response to this situation, a method is proposed to describe the texture, and particularly the degree of non-uniformity of the texture, quantitatively. The data-gathering is by electron-beam back-scattered diffraction, or EBSD, and the mathematics are simple, as the intent is to use the method in industry, for Quality Control purposes. The principles used may also have applications other than sputtering targets.

### Tantalum capacitors: an endangered species?

#### The \$/CV battle for tantalum capacitors continues

by Werner Lohwasser and Daniel Persico, Kemet Electronics

The total tantalum-capacitor market has been flat in the past seven years, after the bubble in 2000. The MLCC market, in contrast, grew by 11% CAGR worldwide since the post bubble 2002. Aluminum polymer capacitors in wounded technology start to compete in fields which so far had been occupied by tantalum polymer capacitors, such as Notebooks.

As in particular high CV MLCC's do address basically the same market segments and applications, this paper addresses the reasons for their different growth rates compared to tantalum

capacitors and the required measures within the entire tantalum capacitor supply chain not only to stay in business, but to explore further growth opportunities.

### A new type of high temperature niobium-tungsten alloy, and a high temperature oxidation coating preparation

by Li Bin, Zhou Xiaojun and Du Linghui, Ningxia Orient Non-ferrous Metals Group

This paper not only describes a production method, but also describes performance testing methods and standards for analysis of the microstructure of a new type of high temperature niobium-tungsten alloy. In addition, it presents the current level of performance and application in a high temperature oxidation coating. The coating was evaluated by testing the specimens on each furnace. The coating has good high temperature oxidation performance at 1600-1800°. Through the microstructure analysis, it was found that the coating consists of four layers and the thickness is 70-130 µm.

The high temperature oxidation coating has been successfully applied in the engine nozzle, chamber and other structural high temperature components of turbines for aerospace applications. With the increasing use of high temperature niobium-tungsten alloy in the aerospace industry, the coating preparation presented has bright prospects.

## HOST COMPANIES

Two member companies are hosting the Forty-ninth General Assembly: Kemet Electronics Corporation and Ningxia Non-ferrous Metals Smelter.

### Kemet Electronics Corporation

Kemet Laboratories was established by Union Carbide Corporation in 1919. In 1987, the management group bought the company from UCC and formed Kemet Electronics Corporation. Recently, the company has acquired the tantalum business of EPCOS AG in April 2006, the Evox Rifa family of companies in April 2007, and Arcotronics in October 2007. Kemet corporate headquarters are located in South Carolina, U.S.A. and production facilities are present in Mexico, China, Italy... The product line includes a very wide range of surface-mount and through-hole capacitor technologies across tantalum, ceramic, aluminium (organic and electrolytic), film and paper dielectrics. The company markets its capacitors to a large and diverse group of original equipment manufacturers (OEMs), electronics manufacturing services (EMS) providers, and electronics distributors around the world. Production is measured in the billions of pieces per year.

Delegates will be offered the opportunity to visit the facility located in Suzhou.





## **Ningxia Non-ferrous Metals Smelter**

Ningxia Non-ferrous Metals Smelter (NNMS) is a leading company and research institute in China's tantalum, niobium and beryllium industries. NNMS is a fast growing company with over 3000 employees. The company is certified under ISO 9002, and has been a member of the T.I.C. since 1992.

Tantalum powder and tantalum wire are its main products, which are well known to capacitor manufacturers across the world.

Other tantalum and niobium products, such as oxides, carbides, rods, ingots, sheets and tubes are also provided to the international and domestic markets. Beryllium copper rods and wires, beryllium sheets and strips, aluminium fluoride, lithium niobate and lithium tantalate single crystals, silicon carbide micropowder, indium-tin oxide powder & target and electronic paste are also important members of its product line.

## **MEMBER COMPANY NEWS**

### **Mamoré Mineração e Metalurgia Ltda**

Mamoré Mineração e Metalurgia Ltda advises that Mr Geraldo Haenel has left his position of Chief Executive Officer. He has been succeeded by Mr Luiz Antonio Ferraz.

Furthermore, on September 19th 2008, Parapanema S.A. has agreed to sell 100% of its shares of Mineração Taboca S.A. and Mamoré Mineração e Metalurgia Ltda to Serra da Madeira Participações Ltda, a subsidiary of Minsur S.A.

### **Kemet Corporation / Vishay Intertechnology**

Kemet Corporation announced on September 15th 2008 that it had sold its Wet Tantalum assets to a wholly-owned subsidiary of Vishay Intertechnology, Inc. Kemet would provide Vishay with certain manufacturing and other services during a transition period.

### **Changes in member contact details**

#### **Ethiopian Mineral Development Share Company**

The nominated delegate to the T.I.C. for Ethiopian Mineral Development Share Company (EMDSC) is now Dr Zerihun Desta. He replaces Mr Musa Edris, who has left the company.

#### **Gippsland Ltd**

The new office address of Gippsland Ltd is:  
Suite 4, 207 Stirling Highway, Claremont WA 6010, Australia.  
Telephone no.: +61 8 9340 6000  
Fax no.: +61 8 9340 6060  
The postal address remains unchanged:  
P.O. Box 352, Nedlands WA 6909, Australia.

The nominated delegate remains Mr Jack Telford.

#### **Metalysis Ltd**

The nominated delegate to the T.I.C. for Metalysis Ltd is now Mr Ian Margerison. He replaces Mr Andrew Fenn.

#### **Metherma KG**

We have been advised of a new address for Metherma KG:  
Arnheimer Strasse 109, 40489 Düsseldorf, Germany.

The nominated delegate remains Mr Rolf Schleenbecker.

#### **MTU Aero Engines GmbH**

The nominated delegate to the T.I.C. for MTU Aero Engines GmbH is now Mr Holger Auer, in the place of Ms Nicole Scherbel.

#### **NEC Tokin Corporation**

The nominated delegate to the T.I.C. for NEC Tokin Corporation is now Mr Shinji Arai. The previous delegate, Mr Yoshihiko Saiki,

has been promoted and transferred to the company headquarters in Tokyo.

### **Rittenhouse International Resources LLC**

Following relocation, the new contact details for Rittenhouse International Resources LLC are:  
P.O. Box 547, Litchfield, CT 06759, U.S.A.  
Telephone no.: +1 860 283 5700  
Fax no.: +1 860 283 0700  
Email (unchanged): dhenderson@rittenhouseir.com

### **Simmonds (Metal Trading) Ltd**

Please note the new address for Simmonds (Metal Trading) Ltd:  
2 Winchmore Court, Station Road, Docking, King's Lynn, Norfolk PE31 8LT, England.

Telephone no. (unchanged): +44 1328 730733  
Fax no. (unchanged): +44 1328 730734  
Email (unchanged): admin@simmondsmetals.co.uk

### **TVEL Corporation**

We have been advised of new contact details for TVEL Corporation.

Address: 49 Kashirskoe shosse, Moscow 115409, Russia.  
Telephone no.: +7 495 988 82 82 (6306)  
Fax no.: +7 495 324 18 77

The nominated delegate remains Mr Vladimir Rozhdestvenskiy.

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