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TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Dear Friends,

In April, members of the Executive Committee along with the Secretary General, Emma Wickens, and the Technical Promotion Officer, Ulric Schwela, met in Brussels.
We reviewed the technical, administrative and social plans for the Forty-ninth General Assembly to be held in Shanghai, China, from October 19th to 22nd 2008.

Kemet Electronics Corporation and Ningxia Non-ferrous Metals Smelter will host this exciting event.

We are pleased to report that the detailed planning and logistics, together with the technical programme are all taking good form. This meeting promises to be engaging and informative for the whole of the tantalum and niobium community. Complete details will be sent out in July to all member companies.

We encourage all attendees to register early and to ensure that visa applications are made in good time.

We look forward to seeing you in Shanghai.

William Young, President

CONTENTS

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 be held at the Westin Bund Center Hotel, where delegates will also stay.

The formal General Assembly of the association will be held on the morning of 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, delegates will be offered the opportunity to take part in 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 delegates.

Invitations will be sent to nominated delegates of member companies in July. Others interested and who have not yet contacted the T.I.C. should do so as soon as possible.

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

- **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

- **Tantalum sputtering target performance**
by John Koenitzer, James Maguire, Lisa Maiocco and David Field, Cabot Supermetals

- **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)

- **Don't be a statistic, report statistics!**
by Ulric Schwela, Technical Promotion Officer, Tantalum-Niobium International Study Center

- **Tantalum supply - back to the future**
by David Henderson, Rittenhouse International Resources, LLC

- **Niobium - the capacity expansion project at CBMM**
by Clóvis Antonio de Faria Sousa, Companhia Brasileira de Metalurgia e Mineração (CBMM)

- **Counterfeit passive components – a growth industry!**
by W.A. Millman, AVX Limited

- **Applications of niobium in superconducting materials**
by Xianghong Liu, Western Superconducting Technologies Co., Ltd

- **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

- **A new method for quantification of texture uniformity of plate**
by Peter Jepson, H.C. Starck Inc and Robert Bailey, Tosoh SMD

- **Tantalum capacitors: an endangered species? The $/CV battle for tantalum capacitors continues**
by Werner Lohwasser and Daniel Persico, Kemet Electronics

- **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

NEW WEAR AND CORROSION RESISTANT SOLUTIONS BASED ON A THIN FILM CORROSION BARRIER OF TANTALUM IN COMBINATION WITH CERAMIC TOP LAYERS

This article was prepared from the paper by Bo Gillesberg of Tantalum Technologies A/S (formerly Danfoss Tantalum Technologies) presented at the meeting of the T.I.C. held in Rio de Janeiro, Brazil, in October 2007.

INTRODUCTION

Tantalum has been used in corrosion applications within the chemical process industry (CPI) for decades. The metal shows superior corrosion resistance in highly aggressive acids such as hot solutions of hydrochloric acid, a medium where most metals including special alloys like Hastelloy tend to fail. Tantalum is, in most situations, applied in a chemically pure form or alloyed with a relatively small amount (a few percent) of tungsten. Hardness, strength and resistance against abrasive wear are therefore limited. Due to these factors and the high price level of the metal, tantalum based solutions are typically designed out whenever possible.

Thin film tantalum coating, such as Tantaline™ marketed by Tantalum Technologies A/S, has recently entered CPI markets as a lower cost option compared to component designs in solid tantalum. Using a CVD type process, that deposits a metallurgically bonded tantalum surface on top of a steel substrate, it is possible to create components with a chemical performance identical to solid tantalum but with improved strength. Tantaline™ tantalum layer has higher hardness than typical forms of tantalum metal. Wear is however still an issue to consider as the corrosion performance depends on a thin film acting as the corrosion barrier.

To build cost-of-ownership optimized solutions for erosion sensitive parts, solutions that combine the Tantaline™ corrosion barrier with wear resistant surface technologies have been evaluated. Target applications are e.g. valves, stirrers and pumps. The work includes an evaluation of traditional hardening techniques such as boriding and nitriding normally applied to steel. Further, the compatibility between thermal spray coatings and Tantaline™ interlayers has been evaluated.

EXPERIMENTS

Tantalum coating

Parts made of austenitic stainless steel (AISi 304 or 316) were covered with a corrosion proof layer of tantalum by the Tantaline™ chemical vapour deposition (CVD) procedure developed by Tantalum Technologies A/S. During the treatment, 20 to 50 micrometers of tantalum were deposited at 700 to 900°C. Alternatively, tantalum coated parts were prepared using a molten salts electro-deposition (MSE) procedure at 700°C. The relatively high deposition temperature by CVD or MSE results in formation of a thin alloy zone between the substrate and the deposited tantalum. This alloy zone prevents the tantalum layer from detaching from the substrate. The integrity of the deposited tantalum layers was verified by exposure to hot (95°C) 20% hydrochloric acid for a period of 48 hours.

Boriding and nitriding

The tantalum treated parts were borided or nitrided at IWT in Bremen. The selected process parameters for boriding and nitriding are shown in table 1. Conventional pack boriding, boriding with an organic precursor in a plasma, plasma nitriding and gas nitriding were applied to the tantalum coated substrates. Generally, parameters of standard processes developed at IWT for steels were taken. If, after one process, the near-surface concentration of the desired element (e.g. boron) was not sufficient, a second process was performed either at higher temperature or with longer duration. Gas nitriding was done in a NH_3/H_2 atmosphere. Pack boriding was done with the samples packed in conventional boriding powder (Ekabor) and SiC filler material in a closed box at atmospheric pressure. Plasma boriding was performed with an organic precursor (trimethylene borate, TMB, $B(OCH_3)_3$). The samples were PVD coated beforehand with a nickel interlayer which is known to serve as diffusion barrier for oxygen and carbon in plasma boriding of steels.

Table 1:
Selected parameters for surface treatment of tantalum treated parts

Parameter	Gas nitriding	Plasma nitriding	Pack boriding	Plasma boriding
Temperature (°C)	580	1000	900	900
Duration (h)	1	2	2 and 6	0.5, 2 and 3
Pressure (hPa)	1000	1	1000	91
Donator	NH_3	N_2	Ekabor	$B(OCH_3)_3$

The surface structure of the samples before and after the treatment was investigated by scanning electron microscopy (SEM).

The treated samples were investigated by Glow Discharge Optical Emission Spectroscopy (GDOES) to obtain element depth profiles of the near-surface zones. This method works by continuously sputtering the sample surface at a diameter of approximately 5 mm. Thus material composing the near surface zone is transferred into the gas phase and ionised. The ions emit a specific radiation which serves for quantifying the respective element. To be able to do this for tantalum containing materials, reference samples with a specific tantalum content below 100 atomic % were prepared in-house by depositing $TaTi_X$ and TaN_X coatings by physical vapour deposition (PVD) and quantified by energy and wavelength dispersive X-ray analysis (EDX, WDX).

Thermally sprayed parts

The tantalum treated parts were covered with a layer of chromium oxide by Praxair Flametal, Parma, Italy. The thickness of the thermally sprayed layer was around 300 micrometers.

Two groups of substrates were used:

1) Stainless steel sandblasted before Tantaline™ treatment
2) Stainless steel ground before Tantaline™ treatment

After the Tantaline™ treatment (before the thermal spraying) the parts were exposed to light sandblasting to secure a mechanical bonding between the tantalum surface and the sprayed ceramic layer. Cross-sections of the parts were evaluated by optical microscopy before and after the thermal spraying. For plasma sprayed parts, the bond strength of the thermal layer was measured by standard procedures (ASTM C633).

RESULTS AND DISCUSSION

Tantalum coated parts

Figure 1 shows SEM images of the untreated surface of pure tantalum, salt bath deposited tantalum and CVD deposited tantalum. The tantalum sheet shows grooves from a grinding process. Tantalum coatings deposited by salt bath or CVD show sharp-edged Ta crystallites, the salt bath crystallites being coarser laterally.

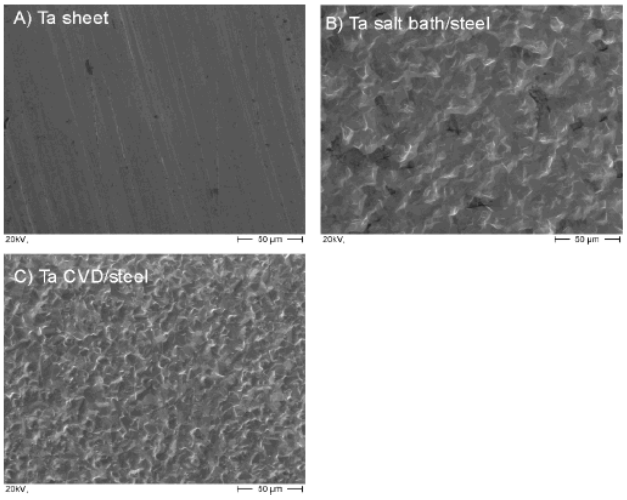


Figure 1: Surface structure of a solid tantalum sheet (A) and stainless steel coated with tantalum by MSE (B) and CVD (C) procedures

Borided and nitrided Tantaline™ parts

The visual appearance of the surfaces was influenced by the final surface treatment. Gas nitriding led to rough and dull surfaces, plasma nitriding yielded a partial flaking of the surface, probably due to residual stresses built up by the treatment. Plasma borided surfaces looked dark also with partial flaking. Pack boriding gave dull and darkened surfaces.

Figure 2 shows selected SEM pictures of differently treated surfaces. Gas nitriding roughens the surface of the different samples significantly (figures 2A and 2B) confirming the dull visual appearance. Obviously, this process destroys the sharp-edged surface structure of the tantalum coatings which is most likely due to compound formation, as will be seen in elemental depth profiling.

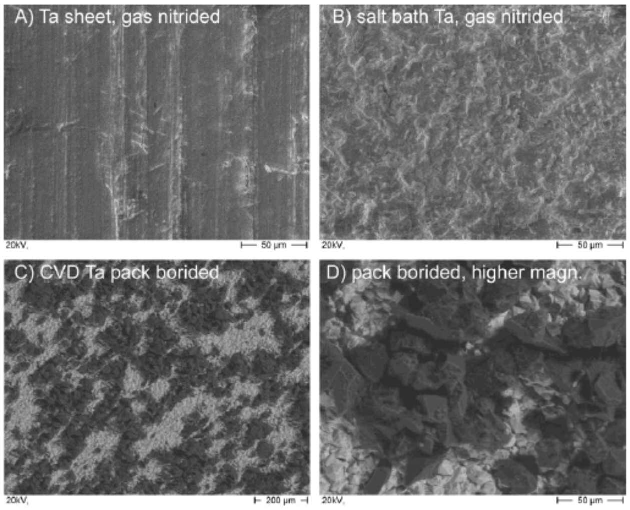


Figure 2: SEM images of gas nitrided Ta sheet (A), gas nitrided salt bath Ta (B) and pack borided CVD Ta (C, D with higher magnification)

The surfaces analysed after pack boriding appeared also roughened with residues from the pack powder still present, as can be seen in figures 2C and 2D for a CVD Ta sample.

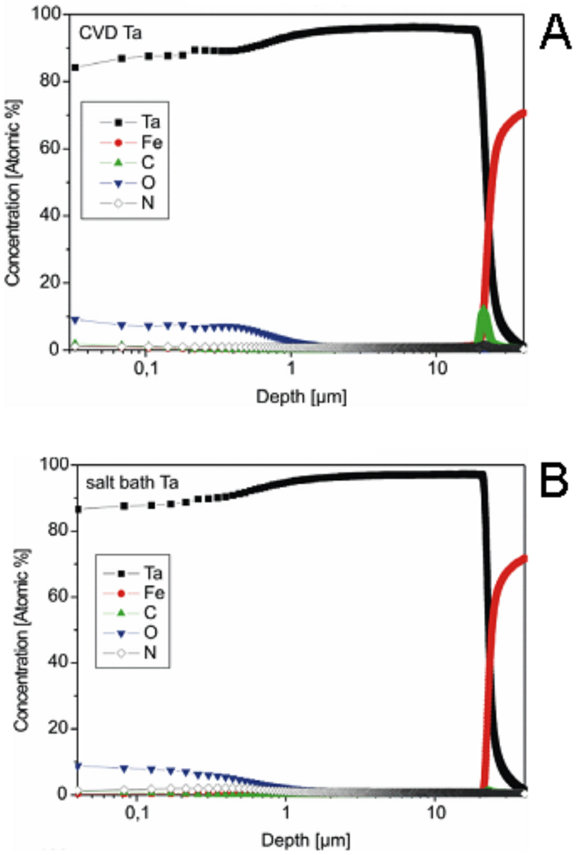
Elemental Depth Profiling

Figure 3 shows GDOES elemental depth profiles for samples 'as-delivered' and with different surface treatments. For the untreated samples (figures 3A and 3B) a signal for oxygen can be seen down to a thickness of approximately 1 micrometer. In a thickness of around 30 micrometers the (Fe) signal from the substrate can be seen, indicating the interface of tantalum and the base material.

It is obvious that a considerable amount of oxygen is present especially after gas nitriding (figure 3C) where no nitrogen is absorbed near the tantalum surface. For gas nitriding, this is explained by the fact that the chamber is simply flooded with process gases so that residual oxygen can react with the tantalum surfaces at higher temperatures.

In contrast, plasma nitriding is performed at low pressure. This leads to about 20 atomic % nitrogen in a layer of about 1 micrometer (figure 3D). The surface roughening observed (figure 2, above) stems from oxidation (gas nitriding) and flaking of the nitrided layer probably due to internal stresses (plasma nitriding).

Plasma boriding with a nickel layer gives a GDOES profile as shown in figure 3F. This process only leads to a low concentration of boron near the surface. Excessive carbon is present and could explain the dark residues on the sample surface. A high amount of oxygen is able to diffuse into the coating despite the presence of nickel serving as diffusion barrier for boriding of steel. The carbon and oxygen contents may arise from the precursor. Furthermore, the depth profile of the tantalum coating is changed (i.e. the tantalum has diffused into the steel substrate) resulting in a broader diffusion zone.



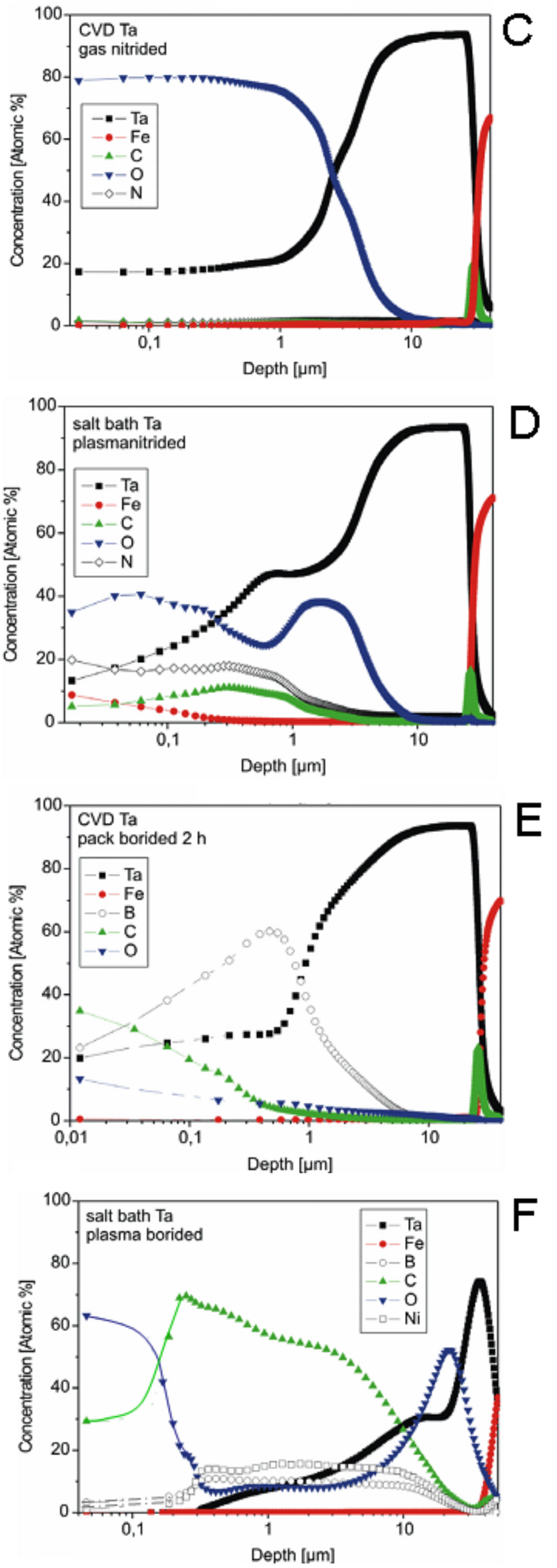


Figure 3: GDOES elemental depth profiles for the samples 'as-delivered' (A- CVD tantalum and B- MSE tantalum) and with different surface treatments (C- gas nitrided, D- plasma nitrided, E- pack borided and F- plasma borided)

In contrast to this, both pack boriding processes (figure 3E) lead to a maximum of about 60 atomic % boron in a depth of 1 - 2 micrometers. Taking the associated tantalum content into account, a TaB_2 layer should have formed. Interestingly, oxidation is hindered by this process despite the fact that it is performed at atmospheric pressure. The oxygen content is below 20 atomic % at the immediate surface. Carbon is present, probably originating from the boriding powder. By increasing the processing time from 2 to 6 hours, some more boron is able to diffuse into the coating.

Thermally sprayed parts

Figure 4 shows the cross-section of Tantaline™ treated parts, which have been sandblasted. As can be seen, the sandblasting creates a rough surface of the tantalum layer. For the parts that have been ground before tantalum treatment (figure 4B) it can be seen that the tantalum layer is still intact after the sandblasting. For the parts that have been sandblasted before tantalum treatment (figure 4A) it can be seen that 'critical points' with low tantalum layer thickness may appear, as marked in the figure. At the critical points, the tantalum corrosion barrier may be penetrated during the subsequent sandblasting. The tests indicate that sandblasting before the Tantaline™ treatment should in general be avoided. The scratches in the stainless steel substrates are preparation artefacts (lapping tracks from hard particles in the polishing cloths).

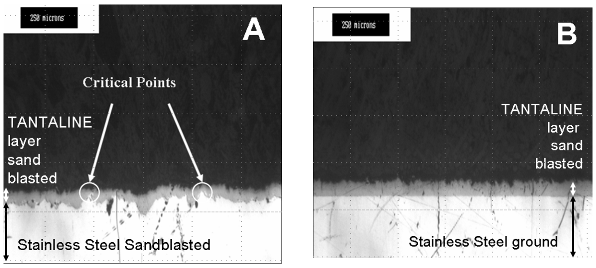


Figure 4: Effect of sandblasting before Tantaline™ treatment.
(A) Stainless substrate sandblasted before Tantaline™ treatment.
(B) Stainless substrate ground before Tantaline™ treatment

Figure 5 shows the cross-section of a Tantaline™ treated part subsequently thermally sprayed with a 300 micrometer layer of chromium oxide. In the figure, the tantalum layer can not be distinguished from the stainless base, since both metals appear much brighter than the ceramic layer and the resin in which the parts were mounted before cross-sectioning. It appears that the interface between the metal and the ceramic layers is free of gaps and the thermally sprayed layer is homogeneous.

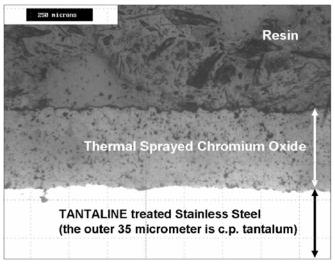


Figure 5: Cross-section of a Tantaline™ treated part subsequently thermally sprayed

The adherence of the deposited ceramic layer determined by pull tests is shown in table 2. The average bond strength was 1995 PSI, approximately 50% of the normal bond strengths measured on steel.

The reason for lower bond strength than normally seen on steels is to be found in the fact that only a light sandblasting has been performed to avoid penetration of the tantalum corrosion barrier. The surface roughness is therefore lower (as can also be seen by comparing the stainless/tantalum interface with the surface roughness in figure 4B). A lower roughness results in a less efficient mechanical bond of the ceramic layer. Higher surface roughness (and improved mechanical bond) is possible on Tantaline™ treated parts, but will require thicker tantalum layers that will increase the cost. The optimal solutions (cost vs. mechanical performance) are expected to be application dependent and are to be evaluated further.

Table 2 :
Bond strength (PSI) of chromium oxide layer sprayed on top of Tantaline™ tantalum layer

Drill number	Bond strength value (PSI)
1	1877
2	2485
3	2090
4	1820
5	2019
6	1678
Average	<X> = 1995 PSI

SUMMARY

Tantaline™ thin layer tantalum coatings have shown good corrosion properties in corrosive media such as hot concentrated hydrochloric acid. A potential problem of thin layer tantalum surface solutions is wear related degradation of the corrosion barrier due to interaction with abrasives in process fluids at high velocities. Different industrially available surface hardening techniques have been investigated to evaluate the compatibility with thin film tantalum surface layers.

Tantalum coated parts have been pack and plasma borided or gas and plasma nitrided. Nitriding and boriding tend to leave residues on the surface leading to roughening. For nitriding, compound formation and diffusion into the bulk seems to be hindered by the higher affinity of tantalum with oxygen at higher temperatures. Pack boriding leads to an increased boron content at the surface of the tantalum, and the diffusion depth can be controlled by the time of the treatment.

Judging from these experiments, pack boriding is the most promising technique for hardening of thin tantalum layers and a good compatibility between Tantaline™ surface treatment and pack boriding can be expected, whereas nitriding and plasma boriding are not suitable for hardening Tantaline™ materials.

Thermal spray coating has been tested in combination with a corrosion protective film of tantalum. By applying a light sandblasting to the tantalum treated parts it is possible to apply sprayed ceramic layers with acceptable adherence without penetrating the corrosion barrier. The compatibility between Tantaline™ parts and ceramic thermal spray coatings is considered to be good.

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VERY HIGH CV TANTALUM-POWDER PASTE – A NEW TECHNIQUE FOR VERY SMALL CAPACITORS

This article was prepared from the paper by Ralph Otterstedt, Marianne Gottschling and Helmut Haas of H.C. Starck GmbH presented at the meeting of the T.I.C. held in Rio de Janeiro, Brazil, in October 2007.

INTRODUCTION

The trend to offer more capacitance in a given volume or footprint, or to offer the same capacitance in a smaller volume or footprint, drives continuously the development of very high CV tantalum powders. However, pressing of very thin anodes using these high CV tantalum powders becomes more and more challenging, due to limits in the flowability of these powders as well as the mechanical strength of the resulting anodes. In particular, anode designs with less than about 250 microns thickness, as desired for microchip- and multianode-capacitors (low ESR), are difficult to produce with current pressing technologies.

We report on a new technique using tantalum-powder pastes and stencil printing on thin tantalum foil which is able to produce ultra low profile anodes and almost any 2D-shape. Furthermore, this technique allows safe handling of highest CV tantalum powders and relaxes demands on the physical properties of the powder and anode such as flowability and green strength. First electrochemical tests of such capacitor anodes show promising results. A simple process to produce high-performance tantalum anodes with high productivity seems to be feasible.

PASTE TECHNOLOGY AND STENCIL PRINTING

Screen and stencil printing is an established cost effective technology in industry. Films of a thickness from a few to several hundred micrometers can be applied with this so called "thick film" technology. Depending on the screen or stencil pattern, continuous layers as well as discrete structures can be formed on smooth, but not necessarily flat, substrates. Many functional materials such as (semi-)noble conductors, catalytically active electrodes for, among others, fuel cells are shaped to the desired dimensions by screen or stencil printing.

The thin inner electrode layers of MLCCs (Multi Layer Ceramic Capacitors) consisting of silver-palladium or base metal alloy are an example of the application of this technology in the electronics industry. Another example is the production of LTCCs (Low Temperature Cofired Ceramics), electronic circuits used in harsh automobile applications where conductor layers of silver-palladium or copper are applied by screen printing.

The core of the screen or stencil printing technology is a paste of the solid material which has to be applied on a substrate. In general, a paste consists of the solid material and a binder system (see figure 1). The binder system comprises as main components a polymer (acrylate, modified cellulose…) and an appropriate solvent. The solid phase is dispersed into the binder phase by mechanical treatments such as roll milling or ball milling, their intensity depending on the strength of agglomerates and the desired degree of dispersion.

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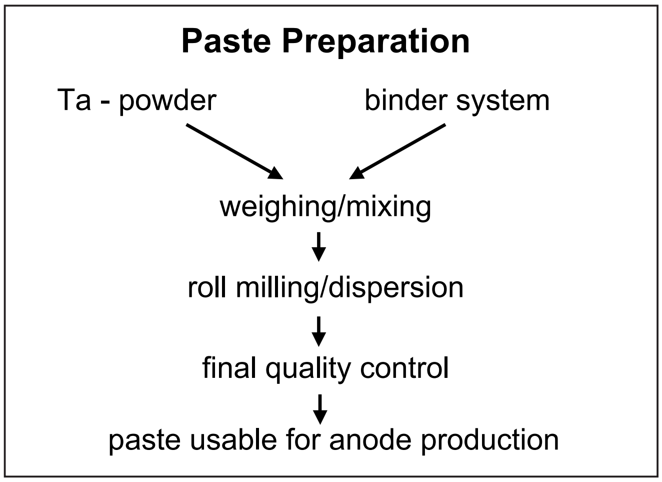


Paste Preparation

Ta - powder

binder system

weighing/mixing

roll milling/dispersion

final quality control

paste usable for anode production

Figure 1: Schematic of high CV tantalum-powder paste preparation

Additives (wetting agents, de-foamers or thickeners) help to fine-tune the properties and processability of the paste. Typical specification features of a paste are solid content, particle size distribution, viscosity at defined stress levels and shelf life (see figure 2), i.e. rheological characteristics.

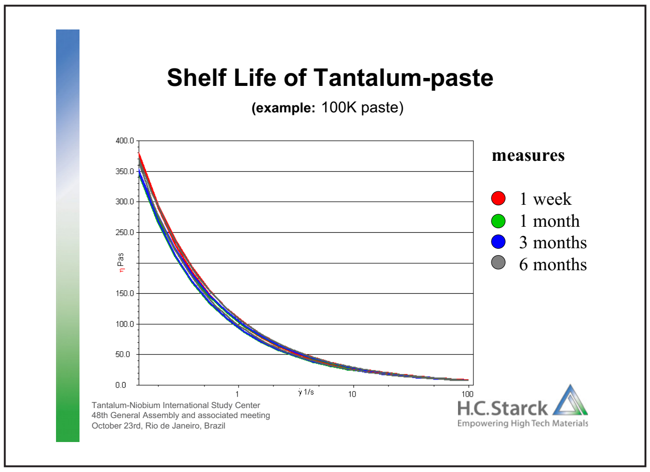


Figure 2: Shelf life of high CV tantalum-powder paste checked by viscosity

The printing process requires an appropriate plastic or pseudoplastic rheological behaviour of the paste (see figure 3), which means that the mechanical stresses defined by the printing process parameters, i.e. stencil layout (see figure 4), must lead to a response of the paste resulting reproducibly in the desired geometry and mass, together with a high productivity (see figures 5 & 6).

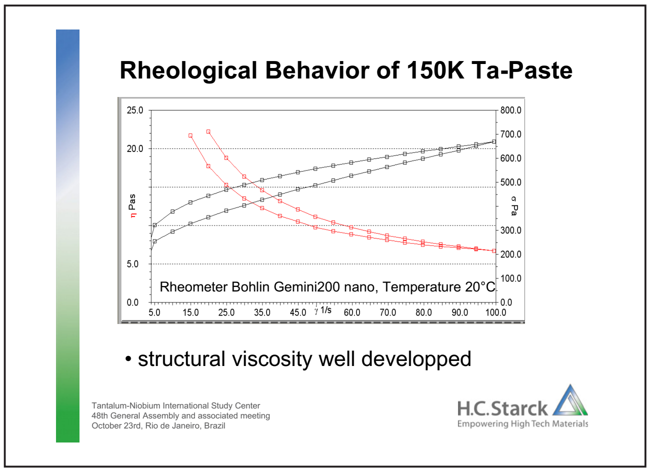


Figure 3: Pseudoplastic rheological behaviour of appropriate high CV tantalum-powder paste

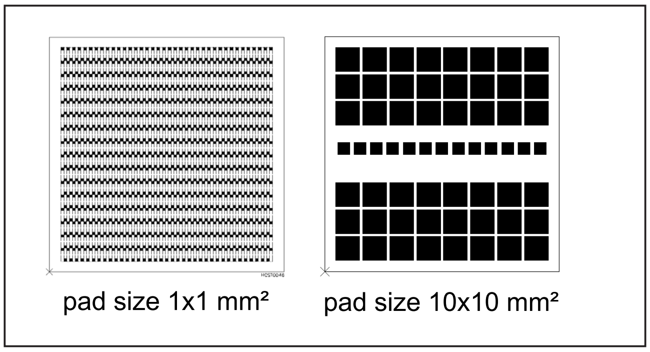


Figure 4: Examples of stencil layouts for ultra-flat small (1x1 mm²) and large (10x10 mm²) high CV tantalum anodes

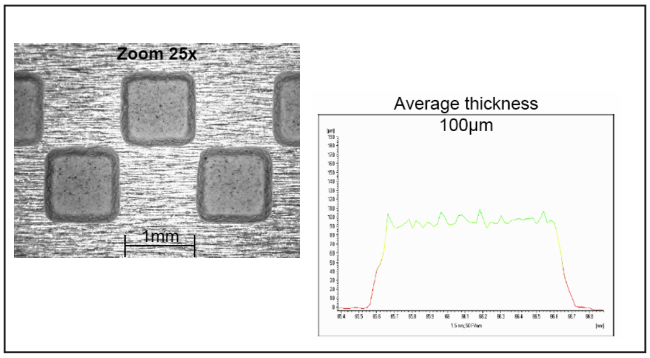


Figure 5: Example of sintered anode having well defined dimensions of 1x1x0.1 mm³

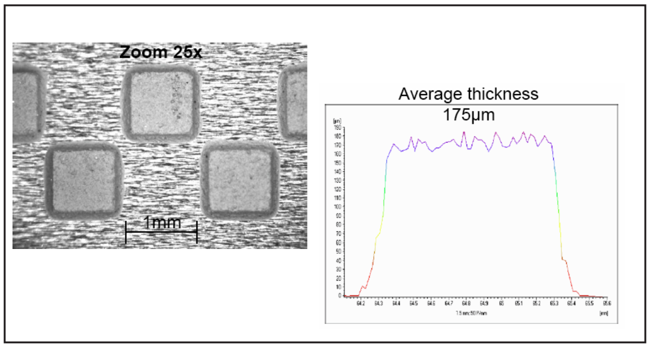
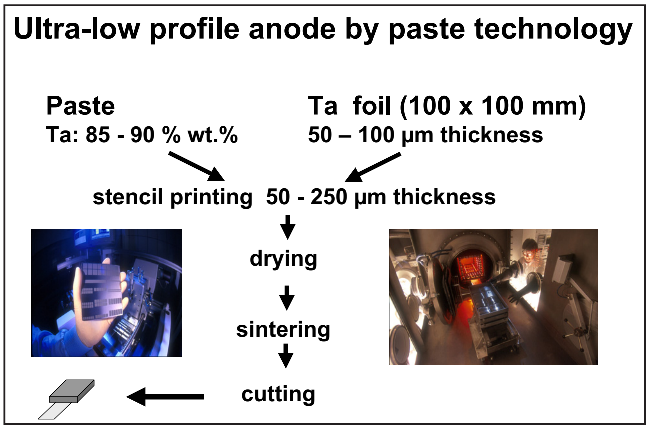


Figure 6: Example of sintered anode having well defined dimensions of 1x1x0.175 mm³

The printing process forms a 'green' body which has to be consolidated by drying and sintering (see figure 7). On a laboratory scale, cutting into single anodes is done by sawing.



Ultra-low profile anode by paste technology

Paste
Ta: 85 - 90 % wt.%

Ta foil (100 x 100 mm)
50 – 100 µm thickness

stencil printing 50 - 250 µm thickness

drying

sintering

cutting

Figure 7: Schematic of anode manufacturing process using stencil printing of high CV tantalum-powder paste

TANTALUM ANODES FROM VERY HIGH CV POWDER PASTES

Tantalum powder (especially high CV tantalum powder) as the solid phase imposes severe restrictions on the drying and sintering conditions and on the choice of the organic binder system. It is well known that the high reactivity of tantalum towards carbon and oxygen can provoke detrimental effects in tantalum capacitors such as low reliability and unstable characteristics with respect to voltage and temperature [1].
H. C. Starck has developed paste formulations for high CV tantalum powders which take account of the needs of tantalum anodes [2].
As an example, figure 8 shows the geometry of anodes printed on 50 µm thick tantalum foil used for laboratory wet tests and figure 9 shows the results of wet tests after 10 and 16V formation in phosphoric acid.

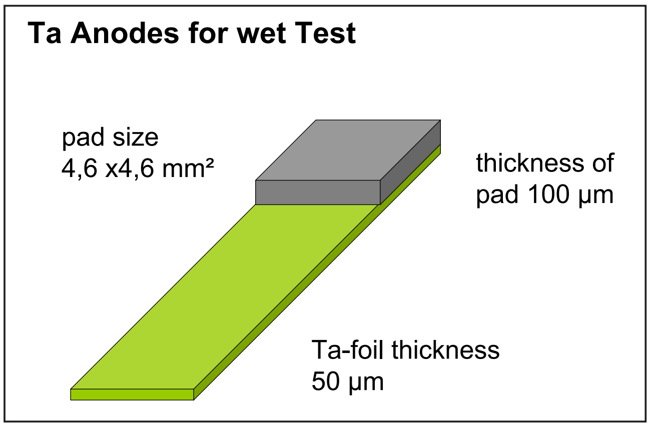


Figure 8: Dimensions of high CV tantalum anodes from 150KA powder paste for wet test

Ta-Powder 150KA

mass/ pad	capacitance/ area	specific charge	specific leakage	formation voltage
mg	µF/ cm^2	µFV/g	nA/µFV	V
11,89	477	136.000	1,10	16
11,41	780	145.000	1,19	10

Figure 9: Wet test results of anodes after 10V and 16V formation

The mass per pad corresponds to a sintered anode height of about 100 µm, i.e. total anode height including the tantalum foil is only 150 µm. The capacitance per square centimetre reaches about 480 µF/cm^2 for 16V formation (6V rated voltage) and 780 µF/cm^2 for 10V formation (4V rated voltage). This is far beyond the values achievable by aluminium-foil capacitors of the same footprint and height. The specific charge of the 150KA powder is almost fully recovered after 10V formation and less than 10% is lost after 16V formation. The specific leakage of about 1 nA/µFV is in a reasonable range.
Further assessment of stencil printed anodes from high CV tantalum-powder pastes, including solid tests and taking into account product specific geometries and process related restrictions, is preferably done in cooperation with established capacitor manufacturers.

CONCLUSION AND OUTLOOK

We have demonstrated that the stencil printing technology using high CV tantalum-powder paste is capable of producing ultra-thin (<250 µm) tantalum anodes for capacitors showing extraordinarily high charge per footprint (and volume). We believe that the potential of this technology is far from being fully exploited, and - with creativity and innovation - powder manufacturers could use tantalum powder of even higher CV than at present and capacitor manufacturers could apply it to ultra-flat, ultra-low ESR customised capacitor designs.

Literature: [1] Y. Freeman et al., Passive Component Industry, January/February 2007, p. 22-29
[2] J. Löffelholz, M. Gottschling, K. Binner, EP 1 114 430 B1

MEMBER COMPANY NEWS

Hellwarth Lahusen

The Tantalum-Niobium International Study Center was sad to learn that Mr Hellwarth Lahusen had passed away in March 2008.
Mr Lahusen was a major figure in the tantalum industry, with a career at the company H.C. Starck of almost 50 years. He was appointed a limited partner in 1956, and became one of three joint managing directors after the death of Hermann C. Starck in 1974, until his retirement on July 1st 1989. This company joined the T.I.C. as soon as membership was opened to processing firms, and Mr Lahusen was always a very keen supporter of the association's activities.

New members

Please find below some information relative to the companies elected to membership by the Forty-eighth General Assembly. For contact details, please see either Bulletin n°132 or the T.I.C. website on www.tanb.org.

GfE-MIR

GfE-MIR is a part of the Varomet Group which maintains a global reputation as a reliable marketer and distributor for a wide variety of commodities. Further information on the Varomet Group can be found at www.varomet.com.

GfE-MIR GmbH specialises in marketing and supplying alloys and related products such as noble alloys, bulk alloys, special alloys, metals, cored wires, powder products and foundry additives for the steel, foundry and non-ferrous industries. The product range also includes tantalum metal, tantalum oxide, niobium metal, ferro-niobium, ferro-niobium HP, niobium oxide and nickel-niobium.

Globe Metals & Mining Limited (formerly Globe Uranium Limited)

This company was called Globe Uranium at the time of election to T.I.C. membership last October. It has however very recently changed name to Globe Metals and Mining Limited.

We have been advised of new contact details.

Address: Level 3, 1060 Hay Street, West Perth,
WA6005, Australia
Telephone no.: +61 89 486 1779
Fax no.: +61 89 486 1718
e-mail address: info@globemetalsandmining.com.au
Web site: www.globemetalsandmining.com.au

The nominated delegate remains Mr Mark Sumich.

Globe Metals & Mining is actively drilling its 100%-owned, multi-commodity niobium-uranium-tantalum-zircon project in central Malawi, named Kanyika. Although originally identified through radiometrics flown in the mid-1980's, it quickly became apparent that niobium is the major value contributor of the four commodities. The pyrochlore mineralisation is hosted in an alkalic granitoid that has been confirmed at surface to extend to 3.5km in strike length. There are up to four parallel zones of mineralisation within the alkalic granitoid.

In March 2008, the company announced a 56 Mt JORC inferred resource estimate for this Kanyika project. A higher-grade component of around 14 Mt was also identified within the overall resource. The high-grade areas are predominantly near the surface, so the company can focus on these areas for initial mining.

A new drilling campaign has begun in June 2008. It comprises approximately 6000 m of RC drilling and 1500 m of diamond drilling. It is mainly designed to upgrade, by way of infill drilling, the JORC resource category of the majority of the 14 Mt high-grade component. This campaign is expected to be completed within three months.

Honeywell Belgium

The key activity of Honeywell in the sector of tantalum and niobium is the supply of high purity KF to tantalum powder manufacturers. The KF is used in the sodium reduction of K_2TaF_7 to tantalum metal, and the grades supplied are principally used in the manufacture of high purity capacitor grade tantalum. Honeywell has been a global supplier of KF to this industry for many years, and the KF grades are manufactured at the production facility in Seelze, Germany (formerly Riedel-de Haen Chemicals), which is certified against ISO/TS 16949, ISO 9001 and 14001. The expertise of this site is in the synthesis and manufacture of industrial scale high purity and ultra high purity inorganic chemicals.

Honeywell's KF technology is part of the Specialty Materials business, a $2.4 billion business providing customers with high-performance specialty materials, including fluorine products, specialty films and additives, advanced fibers and composites, intermediates, specialty chemicals, electronic materials and chemicals and technologies and materials for petroleum refining. The business is based in Morristown, New Jersey (USA).

Irtysh Chemical Metallurgic Plant

The nominated delegate to the T.I.C. for Irtysh Chemical Metallurgic Plant is now Ms Lyazzat Toktagulova, Sales Manager.
Telephone and fax no.: +7 7172 511 293
e-mail address: infoihmz@gmail.com

JSC 'Irtysh Chemical Metallurgic Plant' is a large producer of high purity rare metals: niobium, tantalum, molybdenum and alloys of these metals. The main products of the plant are ingots, plates, bars, powders and rods. The main office is located in the capital of the Republic of Kazakhstan, Astana.

Construction of its plant started in 1955, and the official start of plant activity was announced on September 15th 1960. The plant became a pioneer of the USSR in the production of rare metals and rare earth elements. Today it focuses on production of high purity niobium and tantalum.

Shamika Resources

This company is exploring and developing natural resources on the African continent. It is very actively securing mining rights in the Eastern part of the Democratic Republic of Congo, targeting tin, tantalum, niobium and tungsten.

According to the company, its 'challenge in DRC is to ensure a positive contribution to local communities by reducing poverty, creating sustainable development and enhancing respect of human rights. In pursuing these objectives, Shamika will develop in collaboration with all stakeholders a strong Social and Environmental Program inspired by the Ten United Nations Global Compact Principals and the UN Norms for Business, which include human rights, labor rights and environmental concerns.'

Zimmer – Trabecular Metal Technology

This 'outstanding technical company' makes components for the medical industry applying cutting edge technology employing tantalum in forms specifically for use in the human body. A paper on this subject was presented at the Symposium in 2000.

The cellular structure of Trabecular Metal™ resembles bone and approximates its physical and mechanical properties more closely than other prosthetic materials. The unique, highly porous, trabecular configuration is conducive to bone formation, enabling rapid and extensive tissue infiltration and strong attachment. Trabecular Metal™ implants are fabricated using elemental tantalum metal and vapor deposition techniques that create a metallic strut configuration similar to trabecular bone. Elemental tantalum unites strength and corrosion resistance with excellent biocompatibility.

Changes to member contact details

Gui-Family Tantalum-Niobium Ltd

The nominated delegate to the T.I.C. for Gui-Family Tantalum-Niobium Ltd is now Mr Cao Shuwen.

Hitachi AIC Inc.

We have been advised of new contact details for Hitachi AIC Inc.

Address: Capacitor Business Unit, South Shin-Ohtsuka 11F, 2-25-15 Minami-Ohtsuka, Toshima,
170-0005 Tokyo, Japan.
Telephone no.: +81 3 5219 5581
Fax no.: +81 3 5319 5855

The nominated delegate remains Mr Kazuyuki Iida.

Zhuzhou Cemented Carbide Works

The nominated delegate to the T.I.C. for Zhuzhou Cemented Carbide Works is now Mr Mao Yuting.