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TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Friends,

Here we are in June and hopefully all of the preparations are well under way for your attendance and contributions for this special symposium. The Executive Committee, Technical Promotion Officer and Secretary General have all worked extremely hard to develop a wide-ranging and detailed technical and social programme that will inform and interest our very wide participant audience. This year the statistics will also be comprehensively updated from the previous estimations which I know many of our membership will welcome wholeheartedly. The Transport Committee has made much progress and the membership will have a full update at that time.

In many parts of our industry we continue to see difficult and unsure conditions after a period of consolidation and moderate recovery. In such uncertain times it is even more incumbent than usual to be informed, involved and to contribute to associations such as ours.

I am therefore encouraged that we continue to attract new applicants to join our association and help its further growth and development. The strength and vitality of any association is based upon its membership's personal contributions and I would encourage you all to attend this conference and enjoy the opportunity.

Finally I look forward to greeting you all at the Symposium in October and if time passes as quickly as these past few months then I would encourage all presenters and participants to finalise their arrangements now.

William A. Millman
President

CONTENTS

TANTALUM AND NIOBIUM WORLD

Tantalum and Niobium World, the next International Symposium, will take place in Pattaya, Thailand, from October 16th to 20th 2005. Invitations will be sent to the nominated delegates of member companies; others interested in taking part should contact the T.I.C. secretariat without delay, if they have not already done so.

The Forty-sixth General Assembly will be held on Monday October 17th for member companies, to carry out the business of the association. After a short break for guests to join the member company delegates, the International Symposium will be formally opened with the first technical session. The technical programme is printed in this Bulletin. A broad range of presentations will be offered, from raw materials and the supply chain to recent developments in the use of metals and compounds.

Companies wishing to apply for membership at this General Assembly are reminded that their completed application forms should be returned to the T.I.C. by August 17th 2005.

The registration desk will be open on Sunday October 16th. The first conference event will be a welcome reception on Sunday evening, from 6 to 8p.m.

On Thursday October 20th H.C. Starck will host a field trip to Map Ta Phut to visit the thriving industrial zone there. The group will tour the plant of H.C. Starck (Thailand) and see the tantalum processing carried out at this facility. An alternative tour to the Bayer polycarbonate plant in the same zone will also be offered. A visit to the Tower overlooking the zone will be included, and the group will go to lunch nearby before returning to the Royal Cliff at 4p.m.

A social programme will be arranged for those accompanying the conference participants.

The conference will take place at the Royal Cliff Grand Hotel, where delegates will also stay. This is a splendid hotel situated in a park and close to the sea, as part of the Royal Cliff Beach Resort, with several swimming pools, a variety of restaurants, and a choice of sports and spa facilities, so that participants can relax at leisure after the conference sessions.

Gala Dinner

On Monday evening all delegates and guests are invited to the Gala Dinner, which will be generously sponsored by

Thailand Convention and Exhibition Bureau
and
H.C. Starck group

TECHNICAL PROGRAMME

This is the programme as currently planned: the papers and the order of presentation may have to be changed.

Monday October 17th
The association working for the industry

Review of the statistics of the T.I.C.; industry news from 2004 and the first half of 2005, by William Serjak, Technical Promotion Officer, Tantalum-Niobium International Study Center

Transport of tantalum raw materials: preparing the consultant's report, by Dr Douglas Chambers and Dr Leo Lowe, SENES

Compounds and their applications I
Tantalum compounds as precursors for the semi-conductor industry, by Dr Stephan Kirchmeyer, H.C. Starck

Paper to be advised

Lunch

Using metals and alloys
Niobium in superconductors for the Large Hadron Collider at CERN, by Barry Valder, Wah Chang

Embrittlement of tantalum wires during capacitor manufacture, by Gary Wang, John Moore, Philip Lessner, Kemet Electronics

Development of niobium powder injection moulding, by G. Aggarwal, S.J. Park and I. Smid, CISP, The Pennsylvania State University

Applications of niobium as a catalyst, by Robson Monteiro, Companhia Brasileira de Metalurgia e Mineração

Coffee

Recent developments in the stability of superalloys containing niobium, by Xishan Xie, University of Science and Technology, Beijing

Niobium-based alloys for ultra-high temperatures, by Professor Tanaka, JUTEMI

The value of an integrated tantalum supply chain to the semiconductor industry, Cabot Supermetals

Gala Dinner

Tuesday October 18th
Sources: raw materials and supply chain
Raw material supply and demand, including new sources, by Michael Tamlin, Sons of Gwalia

Tantalum resources in China, by He JiLin and Tu ChunGen, Ningxia Orient Tantalum Industry Co., and Mao MeiXin, Yichun Tantalum and Niobium Mine

Niobium supply chain, by José Isildo de Vargas, Companhia Brasileira de Metalurgia e Mineração

Gwalia operations: overview of factors involved in large scale operations, by Michael Tamlin, Sons of Gwalia

Coffee

Compounds and their applications II
Present status and trends in development of the cemented carbide industry in China, by He JiLin and Liu RuiRui, Ningxia Orient Tantalum Industry Co., and Xie KangDe, Zhuzhou Cemented Carbide Group Corporation

Tantalum and niobium compounds for electronic, optical and catalytic applications, by Dr Karsten Beck, H.C. Starck

Lunch

Tantalum and niobium in the world - Serving mankind and the environment

The use of niobium HY340 in the production of biodiesel, by Robson Monteiro, Companhia Brasileira de Metalurgia e Mineração

Developments in niobium-containing alloys for biocompatible materials, by Professor Niinomi, University of Tokyo

Mechanical compatibility of a niobium alloy for implantation into hard tissue, by Companhia Brasileira de Metalurgia e Mineração

REACH and life cycle assessment: progress of ITRI studies, by Kay Nimmo, International Tin Research Institute

Coffee

Recent advances in microalloyed automotive steels containing niobium, by Shunichi Hashimoto, Companhia Brasileira de Metalurgia e Mineração

Niobium in modern pipeline steels, by Klaus Hulka, Companhia Brasileira de Metalurgia e Mineração

Collection for recycling, and the effect on input for processors, by Michael Tamlin, Sons of Gwalia

Wednesday October 19th
Capacitors and capacitor powder
Tantalum solid electrolytic capacitors: applications and opportunities, by W.A. Millman, Dr T. Zednicek, Dr Z. Sita, Stanislav Zednicek, AVX Tantalum Division; speaker: William A. Millman, Quality and Technical Director, AVX Tantalum Division

New polymer dispersions for solid electrolytic capacitors, Dr Udo Merker, H.C. Starck

Influence of MnO_2 crystal structure on ESR of tantalum capacitors, by Cristina Mota, EPCOS

Tantalum capacitors in more efficient, better performing packages challenge MLCs, by John Prymak, Mike Prevallet, Edward Chen, Kemet Electronics

Coffee

Addressing tantalum capacitors' technology challenges, by Alex Eidelman and Pavel Vaisman, Vishay Israel

Extending the performance of tantalum powders for electrolytic capacitors, by Cabot Supermetals

Niobium oxide capacitors, by W.A. Millman, Dr T. Zednicek, Dr Z. Sita, Stanislav Zednicek, AVX Tantalum Division; speaker: William A. Millman, Quality and Technical Director, AVX Tantalum Division

Tantalum flake for high reliability capacitor applications, by Cabot Supermetals

Close of technical sessions

Lunch

Afternoon at leisure

Thursday October 20th
Field trip to Map Ta Phut: H.C. Starck (Thailand) or Bayer polycarbonate plant. Visit to Tower overlooking the industrial zone. Lunch. Return to Royal Cliff.

TECHNICAL PROMOTION OFFICERS

Ulric Schwela has been appointed as Technical Promotion Officer to the T.I.C. with effect from July 1st 2005.

William Serjak will continue as Technical Promotion Officer until the end of October 2005.

THE TRANSPORT COMMITTEE

A Status Report, June 3rd 2005
William A. Serjak, T.I.C.

The Transport Committee has contracted with the consulting firm of SENES (Specialists in Energy, Nuclear and Environmental Sciences), a Canadian company, to study and report on the possible risk associated with the transport of tantalum raw materials. For the T.I.C. study SENES is represented by Dr Doug Chambers, Executive Vice President and Director of Risk and Radioactivity Studies and Dr Leo Lowe, Principal and Senior Health and Environmental Physicist. SENES has worked successfully on projects that involve Naturally Occurring Radioactive Materials (NORM) including one with the phosphate industry and one with a niobium mining operation. The Transport Committee members are very pleased with the recommendations received from SENES' previous clients.

In March 2005, there was a meeting of the IAEA's Transportation Safety Standards Committee (TRANSSC). TRANSSC decided to convene a Coordinated Research Project to study the regulations concerning the hazardous nature of NORM. The CRP will begin in 2005 and is expected to be completed within 36 months. The Canadian Competent Authority, who is a member of TRANSSC, has agreed to sponsor our project as part of the CRP. The T.I.C. report is expected to be finished prior to the end of 2005, well ahead of the time that the CRP will be finished.

The T.I.C. Transport Committee is currently locating and testing tantalum raw material concentrates, slags and other materials so that the study being conducted will truly represent the tantalum raw materials being transported around the world. Although we have located many raw materials there may be a few that we have not been able to secure. Should your company be in the possession of raw materials from one of the mines in Africa, South America or China and if you are willing to have the materials tested, please contact Leo Lowe at +1 905 764 9380 or llowe@senes.ca to ensure that your material is part of a complete testing programme. Data regarding the source of the raw material and the results of the testing are confidential and will only be known by the consultants. Results used in the report will be completely anonymous. We expect to have the majority of the materials tested by the end of June and a preliminary report ready for presentation to the Committee in September. If you have volunteered to test your own material or have A.H. Knight test your material and have not finalised the testing, you should contact Dr Lowe.

DLA/DNSC

On April 5th the Defense National Stockpile Center announced that in March it had sold tantalum minerals containing 67 000lb tantalum to Umicore of Raleigh, North Carolina, for approximately $US3 million, under the BOA system.

April sales under the same system were announced on May 5th: minerals containing 160 000lb tantalum were sold for approximately $US7.2 million to Ulba Metallurgical and DM Chemi Met. These sales completed the disposal of all mineral concentrates available in fiscal year 2005; the amount sold in the year was about 500 000lb tantalum contained.

Powder and ingots were offered on May 26th, and offers were due by June 1st. It was announced on June 6th that 2200lb vacuum grade tantalum metal ingots had been awarded to Tranzact of Quarryville, Pennsylvania.

In June, bids were due by June 8th for 4500lb tantalum carbide and 7599lb columbium metal ingots, and by June 15th for some 6820lb tantalum metal ingots.

Speaking at Minor Metals 2005 conference, Mr Cornel Holder, the Stockpile Administrator, indicated that plans for simplification of the Stockpile operations were in hand. It was expected that all payments would be made by wire transfer by October 2005, and no cheques would be used; offers and negotiations would be carried out on the internet, eliminating the use of faxes, and to reduce infrastructure all materials would be held in just three locations by FY 2007 – Hammond, Indiana; Scotia, New York; Warren, Ohio – instead of the current 29 locations

MEMBER COMPANY NEWS

Cabot Supermetals KK

Mr Tomoo Izumi has taken over from Mr Jay Yamaguchi as the nominated delegate of Cabot Supermetals KK.

NAC Kazatomprom

Dr Moukhtar Dzhakishev of NAC Kazatomprom accepted the 'leader of Russia's economy' award on behalf of his company, a leading Russian industrial award, reported Metal Pages on March 2nd.

AVX

For the quarter ended March 31st 2005, unaudited net sales were US$306.0 million, reported AVX, and for the year then ended were US$1283.2 million, an improvement of 12.9% over fiscal 2004, 'reflecting the continuing improvement in the electronics industry'. Streamlined operations, reduced operating costs, enhanced production capabilities in low cost regions and lower material costs were cited as reasons for the good results.

Cambior

For the first quarter of 2005 the Niobec mine was 'producing at maximum capacity' and continued 'to enjoy a very strong market for niobium', announced Cambior. Sales of US$12.6 million in the first quarter of 2005 were reported. Improvements in recoveries in the concentrator were proceeding, aimed for completion in September, and a 20% increase in production was planned for the fourth quarter.

continued on page 8

HOW FAR CAN WE GO WITH HIGH CV CAPACITORS?

This paper was given in the technical session of the T.I.C. meeting in Philadelphia, U.S.A., in October 2004 by Dr Yuri Pozdeev-Freeman, Principal Scientist at Vishay Sprague.

Introduction

Solid tantalum (Ta) capacitors have been on the market for more than 45 years since Bell Lab and Sprague Electric launched their manufacture in the mid 1950s. During this period of time many other electronic components appeared on the market, reached their maximum, declined and disappeared, pushed out by newer more advanced components.

The lifetime of any electronic component depends on its ability to improve critical parameters to keep pace with general electronics. The most critical parameter of tantalum capacitors, just like any other type of electrical capacitors, is efficiency CV per unit of volume or mass, where C and V are the capacitance and rated voltage respectively. Miniaturisation, a constant trend for all electronic components, requires a continual increase in the volumetric efficiency CV/cc of tantalum capacitors.

As $C = kA/t$, the capacitance may be increased by increasing the dielectric constant k of the dielectric, reducing its thickness t, and increasing surface area A of the anode (packaging as a common factor in volumetric efficiency is out of the scope of this paper). In reality, the dielectric constant and thickness of the anodic oxide film of tantalum, which is employed as the dielectric in tantalum capacitors, is practically fixed at a given rated voltage. This leaves only one way to improve the volumetric efficiency of tantalum capacitors, which is to increase the specific surface area of the anode.

The anode surface depends on the morphology of the tantalum powder used for the anode sintering. Finer powders with smaller primary particles allow an increase in the specific surface area and lead to miniaturisation of the finished capacitors (Figure 1). In other words, the powder makers have provided the major progress in tantalum capacitors, while the capacitor makers focused on accommodating their technology to the higher CV powders.

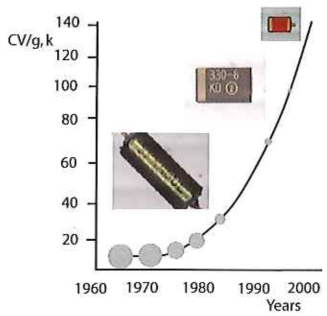


Figure 1: Powder CV vs. time and 330μF – 6.3V capacitor with 11k, 30k and 80k powders

The problem is that the higher the powder CV, the lower the rated voltage of tantalum capacitors with this powder (Figure 2).

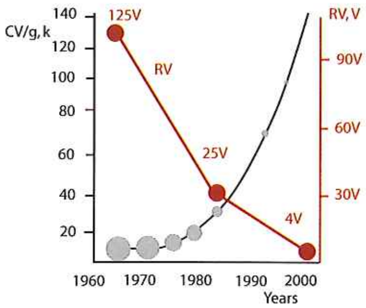


Figure 2: Rated voltage roll-off with increasing powder CV

Figure 2 shows that real progress in volumetric efficiency has been achieved in low voltage tantalum capacitors, where high CV powder is applicable; while high voltage capacitors still use relatively low CV powder.

It is evident from Figure 2 that any further increase in the powder CV will be applicable only to very low voltage capacitors. Some part of modern electronics is moving in that direction and can benefit from super high CV powder. However, the bulk of the tantalum capacitor market lies in the 10V–35V range of rated voltages, where the existing powders have been in use for years. Further progress in these capacitors depends on the capacitor maker's ability to use higher CV powders for a higher voltage product.

This paper describes physical phenomena limiting CV in high voltage and low voltage ranges. A new sintering technique is presented, which allows the CV to be pushed beyond its current limits and capacitors to be made with record high volumetric efficiency and improved DC and AC characteristics.

High voltage and low voltage CV limits

The thickness of the anodic oxide film in tantalum capacitors is directly proportional to the anodising or formation voltage with coefficient 1.6 nm/V at room temperature. From practical experience, formation voltage is typically 2.5–3.5 times larger than rated voltage. A higher formation-to-rated voltage ratio results in a loss of capacitance, while a lower formation-to-rated ratio results in higher DCL (DC leakage) failure rates. The latter indicates that the dielectric is not durable enough to withstand the harsh conditions of the testing and field application.

Figure 3 shows the CV dependence on formation voltage for tantalum powders with 50k, 100k, and 150k CV/g. As can be seen, each powder has a voltage range where the CV is almost constant, and this range becomes smaller with increasing powder CV. There are critical high and low formation voltages where CV starts to roll off. The higher the powder CV, the steeper the CV decrease beyond the critical formation voltages.

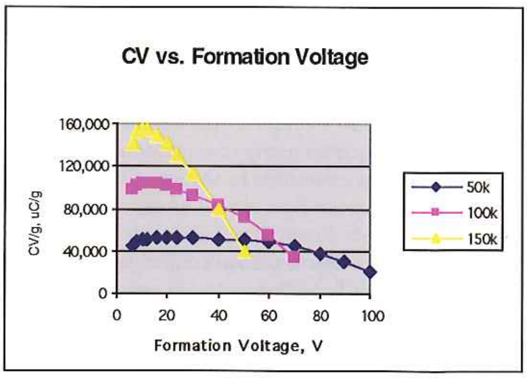


Figure 3: CV vs. formation voltage in different tantalum powders

The CV roll-off at high formation voltage is usually associated with consumption of the necks connecting the powder particles and closure of the pores between the particles by the growing anodic oxide film.[1,2] As a result, some parts of the sintered anode become electrically disconnected, causing the CV to decrease.

Figure 4 demonstrates both these effects in a fracture of a 50k CV/g tantalum anode with 75V formation voltage. It shows that some necks have become very small or even totally consumed, and some pores are practically closed at these conditions. When the size of the necks and pores is significantly reduced, the DCL starts to increase due to local overheating of the anodic oxide film.

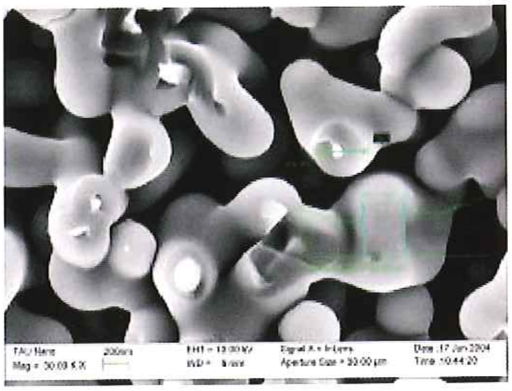


Figure 4: Fracture of the 50k CV/g tantalum anode with 75V formation voltage

The CV roll-off at low formation voltage can be caused by the natural thermal oxide that always covers the surface of tantalum anodes when they are exposed to air after sintering. During formation, the thermal oxide becomes incorporated into the growing anodic oxide.[3] When the thickness of the thermal oxide becomes comparable to the thickness of the anodic oxide, the CV starts to decrease.

The thermal oxide has non-uniform thickness and structure with crystalline inclusions scattered in the amorphous matrix (Figure 5).[3]

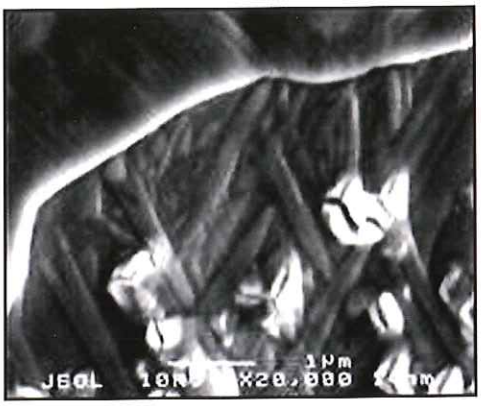


Figure 5: Thermal oxide on tantalum surface

As a result, the thermal oxide has poor dielectric properties, which causes DCL to increase simultaneously with the roll-off of CV at low formation voltage (Figure 6).

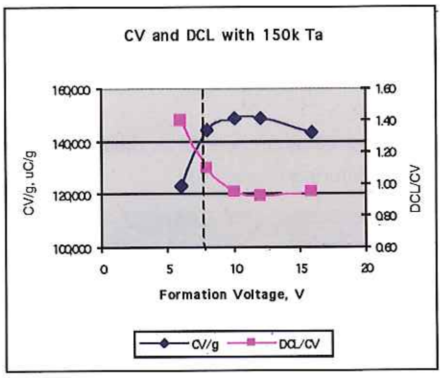


Figure 6: CV and DCL with 150k Ta powder

From the above, the high voltage CV limit can be extended by a combination of:
- Thicker necks connecting the powder particles,
- Larger pores between sintered particles,
- Smaller formation-to-rated voltage ratio (thinner dielectric).

From a practical standpoint, the sizes of necks and pores are in contradiction to each other. Higher pressed density and sintering temperature result in thicker necks but smaller pores due to increased shrinkage of the sintered anode. Lower pressed density and sintering temperature result in larger pores but thinner necks and also in poor lead-to-pellet attachment.

The low voltage CV limit can be extended by reducing the thickness of the natural thermal oxide on the tantalum surface. When measured on pure tantalum foil, this thermal oxide is only 2.5–3nm thick. However, it can grow much thicker on porous anodes. This is due to a high surface-to-volume ratio in the powder particles, and, thereby, a stronger effect of heat released by Ta-O chemical reaction. The passivation process, a gradual increase of oxygen content in a cooling chamber after sintering, helps limit the temperature; however, the thermal oxide grows rapidly on some crystalline grains even with a small temperature increase.

SINTERING AND Y-SINTERING

To extend the high voltage and low voltage CV limits and improve the quality of high CV tantalum capacitors, a special "Y"-sintering process was developed.[4] In this process the powder sintering is performed in the presence of a getter material, magnesium vapour, which removes oxygen from the tantalum by the chemical reaction between magnesium and oxygen. In contrast to that, the oxygen content in high CV tantalum powder

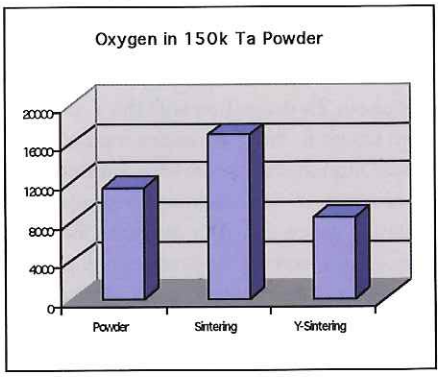
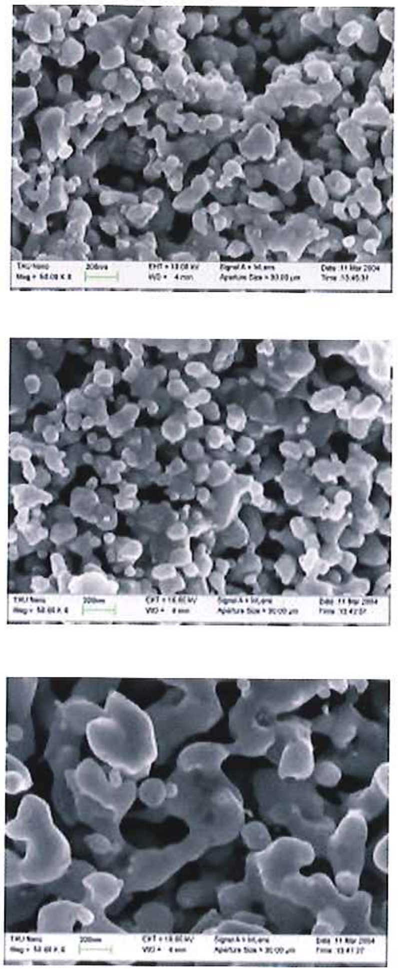


Figure 7: Oxygen in 150k tantalum powder non-sintered, sintered in vacuum, and Y-sintered

increases during conventional sintering in vacuum (Figure 7). This increase is due to the dissolving of oxygen from the natural surface oxide into the particle volume.[5]

The morphology of tantalum powder is different for conventional sintering and Y-sintering (Figure 6).



(a)

(b)

(c)

Figure 8: Morphology of 150k Ta powder non-sintered (a), sintered (b), and Y-sintered (c)

It can be seen that conventional sintering does not noticeably change the particle sizes, while pores, especially large ones, become smaller than in non-sintered powder. This correlates with the powder shrinkage during conventional sintering. In contrast, Y-sintering provides growth of both particles and pores simultaneously. Without oxygen, which is a sintering inhibitor, active diffusion interaction takes place between the powder particles at a relatively low temperature. This allows small particles to be dissolved into large particles without shrinkage of the sintered anode. This effect is demonstrated in Figure 9, where one can see about 10% shrinkage with conventional sintering and about 2% expansion with the Y-sintering.
It is clear from Figure 8, that the surface area of the Y-sintered powder is lower than that with conventional sintering. However, capacitance readings at wet check were close to each other for these two sintering processes. This indicates that there is some 'ballast' surface area, coming from very small particles and pores, which does not contribute to capacitance but raises the oxygen content in sintered anodes. Removal of this 'ballast' surface area by Y-sintering provides full capacitance recovery and almost ideal AC characteristics to high CV tantalum capacitors (Figure 10).

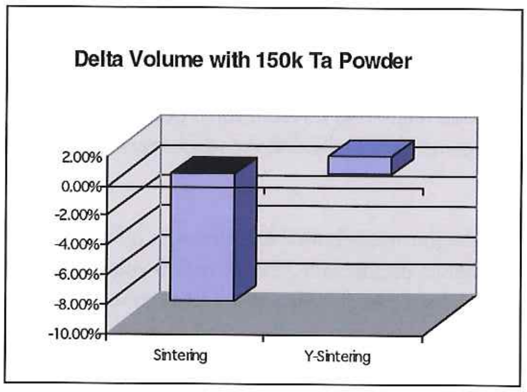


Figure 9: Change in volume of 150k Ta anodes after sintering and Y-sintering

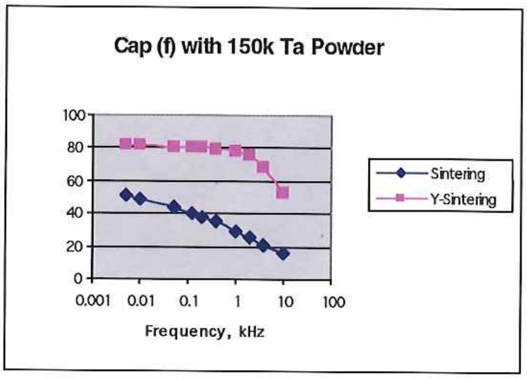


Figure 10: Capacitance vs. frequency with 150k Ta powder

As expected, the larger necks and pores from Y-sintering extend the high voltage CV limit. Figure 11 demonstrates this effect for 50k Ta powder.

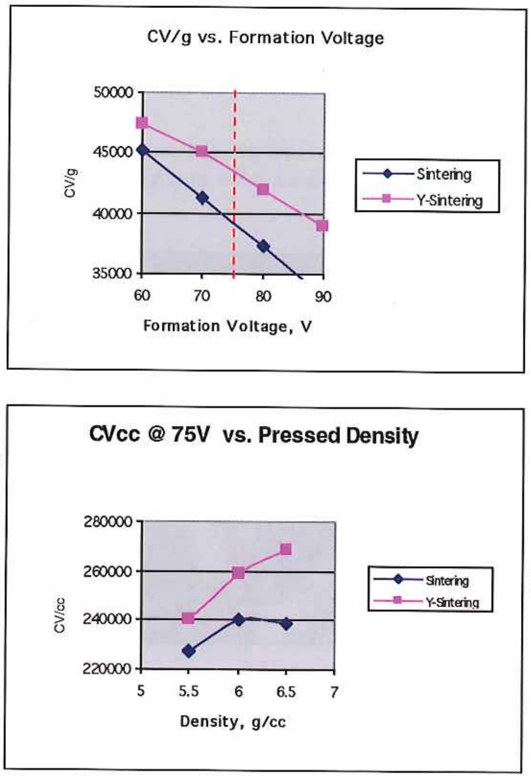


Figure 11: CV vs. formation voltage (a) and pressed density (b) with 50k Ta powder

From Figure 11a, the Y-sintering results in higher CV/g at high formation voltages. From Figure 11b, it also results in higher

CV/cc at higher pressed densities, while conventional sintering does not cause a gain in capacitance with increasing pressed density. The latter effect is because of the difference in the volume change during conventional sintering (shrinkage) and Y-sintering (small expansion).

CRYSTALLISATION

Crystallisation of the amorphous matrix of the anodic oxide film is the major reason for the degradation and failure of high voltage tantalum capacitors.[6] Crystalline inclusions grow in anodic oxide film and eventually disrupt this film causing catastrophic failure of the capacitor (Figure 12).

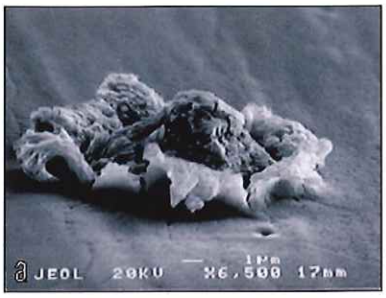


Figure 12: Crystalline inclusion in anodic oxide film of Ta

The crystallisation starts from very small crystallization nuclei on the Ta-Ta_2O_5 interface, which were revealed by removal of the amorphous matrix and investigation of the anode surface (Figure 13).[7]

Figure 13: Crystalline nuclei on Ta surface inside anodic oxide film (x 20 000)

The number and size of the crystallisation nuclei are directly proportional to the oxygen content in the Ta anode. When oxygen is low and the nuclei are small, they may be cut off the anode surface by short term annealing (Figure 14).[7]

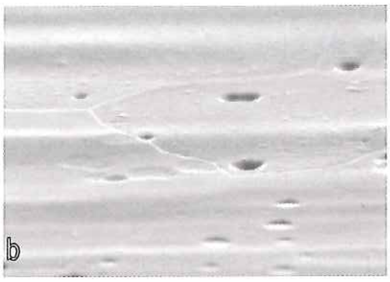


Figure 14: Sockets of Ta surface after cutting off the crystalline nuclei (x 20 000)

A simple explanation can be offered for this phenomenon. During the annealing the Ta_2O_5 film undergoes a high mechanical stress due to a large difference in the coefficient of the thermal expansion between the Ta and Ta_2O_5 phases (8x10-7K-1 and 6,5x10-5K-1 respectively). These thermal stresses can relax by sliding (shear) of the Ta_2O_5 film along the Ta_2O_5/Ta interface. Because the crystallisation nuclei are attached to the tantalum surface and sit inside the amorphous film, this sliding will cause mechanical cutting of the nuclei along the metal surface.

The conventionally sintered anodes have high oxygen content in their volume and, therefore, high density of crystallisation nuclei in anodic oxide film. This makes the anodic oxide prone to crystallisation and requires higher formation-to-rated voltage ratio to slow down the crystallisation process. As a result, the volumetric efficiency of tantalum capacitors with conventionally sintered anodes decreases.

The Y-sintered anodes have very low oxygen in their volume and thereby low density of small crystalline nuclei in anodic oxide film. These nuclei can be relatively easily cut off the tantalum surface by short term annealing following the formation process. This makes tantalum capacitors with Y-sintered anodes resistant to crystallisation and allows lower formation-to-rated voltage ratios, which increases the volumetric efficiency.

THERMAL OXIDATION

Thermal oxide of tantalum, which forms rapidly on the tantalum surface when tantalum anodes are exposed to air after sintering, plays a crucial role in the quality of low voltage high CV capacitors. It causes CV losses and DCL increase and limits the powder CV applicable for making low voltage capacitors.

Low oxygen in Y-sintered tantalum anodes helps to suppress thermal oxide growth on the tantalum surface. Figure 15 shows SIMS oxygen depth profiles for pure tantalum and tantalum saturated with oxygen subjected to similar thermal treatment in air.

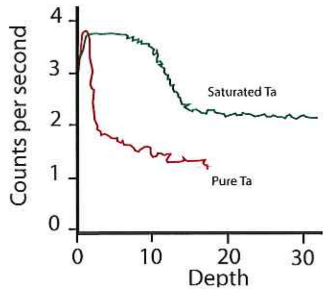


Figure 15: SIMS oxygen depth profiles for thermal oxide on pure tantalum and tantalum saturated with oxygen

It is clear from Figure 15 that thermal oxide on the pure tantalum is much thinner than it is on the tantalum which is saturated with oxygen. The reason for this effect is that pure tantalum dissolves oxygen in its volume, while the tantalum saturated with oxygen has no room for new oxygen to dissolve. That is why the oxygen absorbed from the air stays on the surface of the tantalum, building up the thermal oxide.

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The T.I.C. is an *association internationale* under Belgian law.

CONCLUSION

For more than 45 years in the history of tantalum capacitors, progress in their most critical parameter, volumetric efficiency, was chiefly provided by the powder makers, who developed new powders with finer primary particles and, thereby, larger specific surface area. This way has practically ended with the only exception, very low rated voltage capacitors. Across the major range of the rated voltages, tantalum capacitors are facing high voltage and low voltage limits preventing a further increase in CV. These limits come from size effects when the thickness of the anodic oxide film becomes comparable with the thickness of the necks connecting the powder particles, the size of pores between the particles, and the thickness of the natural thermal oxide on the tantalum surface.

The new way of sintering tantalum anodes with existing powders, Y-sintering, pushes the CV beyond current limits and allows the manufacture of capacitors with record high volumetric efficiency and improved DC and AC characteristics. This is due to low oxygen in Y-sintered anodes, improved morphology (thick necks and open pores), strong lead-to-pellet bonding without shrinkage, and low thickness of the thermal oxide on the surface of the tantalum. As an example, A-case 25V rated voltage capacitors with conventional sintering have maximum 4.7µF capacitance, while the Y-sintering provides 10µF–25V CV in the same case-size or double volumetric efficiency.

The Y-sintering is only the first step in the new high CV technology where major manufacturing steps are designed on the basis of a uniform physical model. With this technology, tantalum capacitors will continue to improve their volumetric efficiency and other critical parameters, keeping a strong position in the market for passive electronic components.

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ROSKILL REPORT

The Economics of Tantalum', ninth edition, 2005, is now available from Roskill Information Services Ltd., 27a Leopold Road, London SW19 7BB, UK. Tel.: +44 20 8944 0066, fax: +44 20 8947 9568, web site: www.roskill.co.uk.

The opening summary contains facts and observations which the T.I.C. considers pertinent, and with which our association would largely agree.

The main sections of the report have been considerably re-worked since the 1999 edition, so that the very long chapter on 'production' has now become 'production and processing', which makes the information more meaningful. The treatment on a country-by-country basis offers some surprises, and the report suffers from the perennial difficulty of collecting, comparing and presenting statistics as it struggles with 'tonnes of mineral', 'tonnes of metal' and data in terms of 'tantalum content' and 'tantalum pentoxide content'.

The T.I.C. quarterly Bulletin has been very extensively used and quoted, as has the T.I.C. web site, and both appear to have been used as inspiration for Roskill's research. T.I.C. statistics have mostly been quoted as 'world' statistics, whereas they represent data collected from our member companies and we state this constantly, and we are aware that their coverage as a proportion of world data varies from category to category. Although there is a comment about our data being estimates, most T.I.C. figures are quoted as 'reports' and the 2002 and 2003 data which were estimated are not described as such. There is also some confusion in the report concerning the source of information: papers appearing in Symposium Proceedings and in the quarterly Bulletin under the names of their authors are widely quoted as T.I.C. statements, and are therefore confused with T.I.C.'s own published material.

There is a wealth of information in this report, which should broaden the knowledge of many in the industry and newcomers alike.

MEMBER COMPANY NEWS

Cabot

Cabot Corporation, parent of Cabot Supermetals, announced a net loss of US$50 million for the quarter ended March 31st 2005, compared to a profit of US$35 million in the preceding quarter. Among the reasons given were the continuing trend towards the use of smaller tantalum capacitors with less tantalum needed for each capacitor, and high inventory levels in the tantalum supply chain. The company had lowered its expectations for the future performance of the Supermetals Business.

In March Cabot announced the official opening of its Thin Films facility in Etna, Ohio, producing tantalum sputtering targets.

Kemet

Kemet has appointed Per-Olof Loof as Chief Executive Officer.

The company reported a net loss (before special charges) of US$16.7 million for the quarter ended March 31st 2005, and net sales of US$101.4 million, an increase of 6.2% over the preceding quarter. Mr Loof was encouraged by a trend in new orders, and was also pleased to report reduced inventories. Reduction in the work force continued as planned.