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TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Dear Friends,

The T.I.C. plans to hold its Forty-ninth General Assembly on Monday October 20th as part of a meeting from October 19th to 22nd 2008 in Shanghai, China. Kemet Corporation has graciously offered to host a plant tour to its Suzhou manufacturing facility. The operation is a reasonable bus ride from Shanghai.

After the great success of our meeting in Brazil last year we expect this year's meeting also to attract a large number of members, guests and interested parties.

Therefore, we would like to encourage all of you to contribute to this meeting with suggestions for technical, commercial or more general papers to report on the progress our industry has made and more importantly, the expectations for the future.

In mid-April, there will be a meeting in Brussels of the members of the Executive Committee, the Technical Promotion Officer and the Secretary General to prepare the programme for the forthcoming General Assembly.

We would also like to hear your ideas and proposals on how we might improve our association and the service we provide to our members and would welcome your contribution to our deliberations.

William Young, President

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

SHANGHAI, OCTOBER 2008

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 technical presentations will cover a wide range of aspects of the industries of both tantalum and niobium, in two half-day sessions to allow delegates a little spare time.

The business and administration of the association will be carried out in the formal General Assembly on the morning of Monday October 20th, including election of applicants for membership and the appointment of the members of the Executive Committee.

A plant tour will be organised on Wednesday October 22nd and delegates will be able to visit the facility of Kemet Electronics in Suzhou.

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 billions of pieces per year.

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. There will also be sightseeing tours for those accompanying delegates.

Invitations will be sent to the nominated delegates of member companies about three months ahead of the meeting. Others who would like to attend should contact the T.I.C. as soon as possible.

STABLE, RELIABLE AND EFFICIENT TANTALUM CAPACITORS

This article was prepared from the paper by Yuri Freeman and Philip Lessner of Kemet Electronics Corporation presented at the meeting of the T.I.C. held in Rio de Janeiro, Brazil, in October 2007.

High stability, reliability and efficiency make tantalum capacitors attractive for commercial and special electronics. The major challenge in achieving these characteristics comes from the anodic Ta_2O_5 film, which is used as dielectric in tantalum capacitors. This dielectric is very thin (20 – 400 nm depending on formation voltage). It is also thermodynamically unstable, which causes spontaneous migration of oxygen from the Ta_2O_5 film into the tantalum anode as well as ordering and crystallization of the amorphous matrix of the dielectric. Both these degradation processes are intensified by temperature and voltage and result in D.C. leakage (DCL) increase and failure of tantalum capacitors.[1,2] In the case of oxygen migration, DCL increase is caused by oxygen vacancies in the Ta_2O_5 film adding free current carriers to the dielectric. In case of crystallization, DCL increase is caused by higher mobility of current carriers in the crystalline phase. Besides, growth of crystalline inclusions in the amorphous matrix of the Ta_2O_5 film creates mechanical stress, which eventually causes cracks in the dielectric and, thereby, shorting of tantalum capacitors.

To address these issues, manufacturing of tantalum capacitors should focus on suppressing the degradation processes by kinetic means, making degradation rate negligible under the harshest application conditions. As this paper shows, this is a realistic approach, which provides low and stable DCL at highest possible temperatures and voltages while still achieving high volumetric efficiency (CV/cc) in the finished capacitors.

LOW AND STABLE DCL

DCL increase due to oxygen migration is more pronounced in low voltage tantalum capacitors, where the thickness of the Ta_2O_5 film depleted with oxygen is comparable to the total thickness of the dielectric. Doping of tantalum powder and anodes with nitrogen (which occupies oxygen positions in the crystalline lattice of tantalum), doping of the Ta_2O_5 film with phosphorus (which slows down oxygen diffusion in the dielectric), thermal treatment of the dielectric (which stabilizes the Ta/Ta_2O_5 interface) are the major techniques which help to slow down oxygen migration in tantalum capacitors and prevent DCL increase caused by this migration.[1]

DCL increase due to crystallization of the amorphous matrix of the Ta_2O_5 film is more pronounced in high voltage tantalum capacitors. The crystallization starts with small initial crystals on the anode surface which continue to grow into the amorphous Ta_2O_5 film during its formation and during further steps of manufacturing and testing of tantalum capacitors. To reduce size and density of the initial crystals, tantalum powder and sintered anodes should have low concentration of impurities, especially oxygen, carbon and transition metals. Since oxygen is naturally added to tantalum anodes during their sintering, deoxidizing by magnesium[3] and controlled passivation[4] should follow anode sintering. Use of phosphorus-containing electrolytes and controlled current density prevent growth of the initial crystals during the formation of the Ta_2O_5 film.[5,6] Post-formation heat treatment, breaking initial crystals from the anode surface, suppresses the crystallization process during further steps of capacitor manufacturing and testing.[7]

When the described package of techniques, reducing concentration and size of initial crystals and preventing their growth, is implemented, the dielectric remains amorphous during testing and field application. As a result, DCL stays low for a long period of time even in conditions which are much harsher than normal application conditions. For example, figure 1 shows DCL distribution in D-case tantalum capacitors 22 µF – 20 V as manufactured (a) and after 2000 hours of life test at 1.32 working voltage (WV) and 85°C (b). The capacitors were made with the crystallization preventing package of techniques (test) and with conventional technology (control).

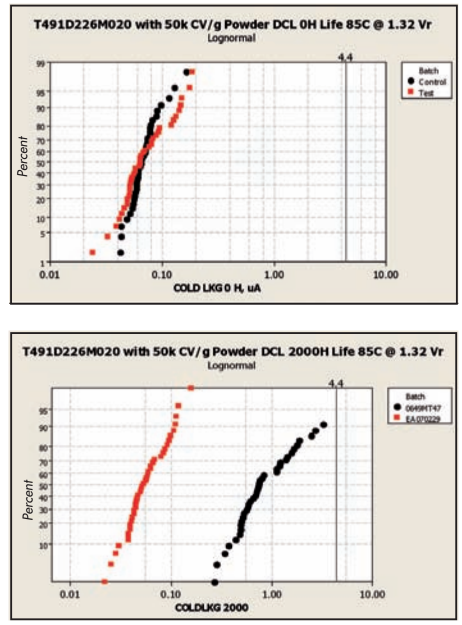

Figure 1: DCL distribution in D-case tantalum capacitors 22 µF – 20 V as manufactured (a) and after 2000 hours life test (b)

As can be seen from figure 1, the initial DCL was well below the limit and practically identical for both test and control parts. Only parts with the test technology remained at low DCL during the life test, while the DCL in the control parts increased by more than one order of magnitude. In some of the control parts, DCL exceeded the limit, causing parametric and catastrophic failures of the tantalum capacitors.

An important feature of the capacitors presented in figure 1 was that they were made with 50k CV/g tantalum powder. This is the highest CV/g powder in the industry applicable for 20 WV capacitors. Use of higher CV powder provides higher volumetric efficiency to tantalum capacitors, however, it also promotes crystallization of the dielectric and, thereby, DCL increase during testing and in the field. Nevertheless, even with this powder, capacitors made with the package of crystallization preventing techniques demonstrated low and stable DCL during long accelerated testing.

BREAKDOWN SIMULATION SCREENING

Using the highest purity tantalum powder and advanced capacitor technology can not guarantee that all the finished capacitors have an ideal, flawless dielectric. Some of the finished capacitors may have defects in their dielectric due to occasional contamination or damage coming from machinery malfunction or from human factors.

Hidden defects in the dielectric, which are not healed by the end-of-line ageing and detected by final electrical testing, can progressively worsen during field application and cause failure of a capacitor. That is why accelerated ageing, surge test, re-flow test, etc. are incorporated into the manufacturing of tantalum capacitors to display hidden defects in the dielectric and to screen out non-reliable parts. The problem with these techniques is that they cannot guarantee exclusion of all the non-reliable parts and, when intensified, can deteriorate the performance and the reliability of the general population of capacitors as a result of the testing.

That is why a special screening technique was developed which allows screening of non-reliable capacitors with hidden defects in the dielectric without any damage to the general population of capacitors. This technique also allows screening of the most reliable 'space quality' capacitors for special applications which can not tolerate even the smallest probability of a failure.

The screening is based on a simulation of the breakdown voltage (BDV) test without actual damage to the parts. BDV test is an ultimate test of the dielectric in the capacitors. Low BDV indicates defects in the dielectric and, therefore, a high probability of failure in the field. High BDV indicates flawless dielectric and, therefore, reliable field performance. As an example, figure 2 shows the distribution of screening voltage within a lot of X-case solid tantalum capacitors 100 µF – 16 V. Screening voltage correlates with actual BDV in individual capacitors.

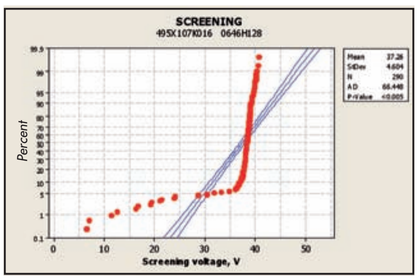

Figure 2: Distribution of screening voltage in X-case tantalum capacitors 100 µF – 16 V

As can be seen, about 95% of the distribution lies in a narrow range of voltages (general population), while 5% of the distribution spreads out towards low voltages ('tail').

DCL readings in all the parts were much lower than the DCL limit for this rating (figure 3). According to figure 3, DCL readings were practically unchanged during the screening, which confirms its non-destructive nature.

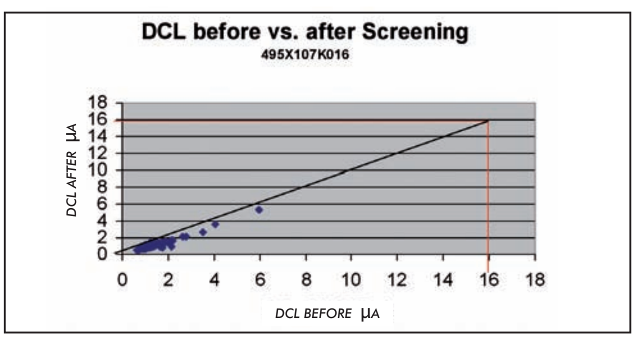

Figure 3: DC leakage in X-case tantalum capacitors 100 µF – 16 V before and after screening

Twenty capacitors from the tail and from the general population were submitted to a highly accelerated test at elevated temperature and voltage. About 30% of the capacitors from the tail failed catastrophically and burned during the test (figure 4a), while no failures or DCL increase occurred in the general population (figure 4b).

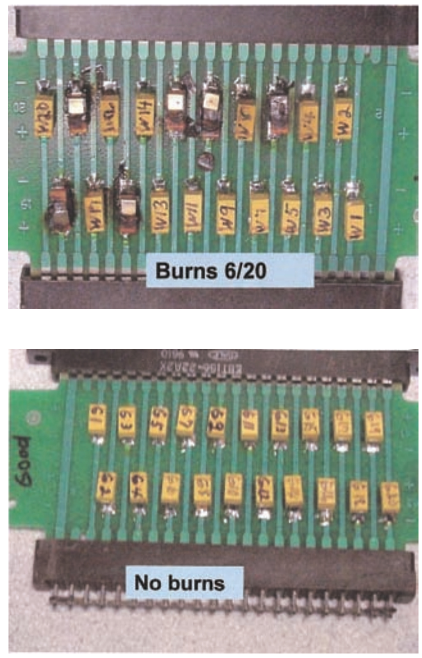

Figure 4: Circuit boards with tested parts from the tail (a) and the general population (b)

Figures 1 to 4 demonstrate that a combination of advanced manufacturing techniques and breakdown simulation screening confers low and stable DCL and outstanding reliability to tantalum capacitors.

Another way to reduce and stabilize DCL in tantalum capacitors, which is widely used in many applications, is to reduce electrical field in the dielectric. This can be accomplished either by increasing form-factor, which is a ratio between formation voltage and working voltage, or by de-rating, which is a ratio between application voltage and designed working voltage. In both cases DCL reduces exponentially and the rate of degradation processes, provoking DCL increase, also reduces exponentially. The problem with this approach is that volumetric efficiency CV/cc of tantalum capacitors is inversely proportional to both formation factor and de-rating. Losing volumetric efficiency makes tantalum capacitors less capable of competing with ceramic capacitors, which are rapidly improving their volumetric efficiency due to thinner dielectric, higher dielectric constant and larger layer count. That is why the real challenge for tantalum capacitors is to combine high stability and reliability with the highest possible volumetric efficiency.

VOLUMETRIC EFFICIENCY

Traditionally, the only way to increase volumetric efficiency of tantalum capacitors was to reduce particle size in tantalum powders and thereby increase surface area of the anodes (this leaves aside packing efficiency as a common issue for all types of capacitors). Though powder vendors continue to increase powder CV, application of newly developed high CV powder is limited to low working voltage capacitors. Higher voltage capacitors can not use high CV powder because they require thicker dielectric than the low voltage parts. The thicker dielectric is growing through the 'necks' between the powder particles and clogs the fine pores between particles, which reduces the surface area of the anode and, thereby, CV. This means that for mid and high voltage capacitors, which constitute the bulk of tantalum capacitors, the suitable powders have been in use for a long time.

Utilization of tantalum in tantalum anode, as a ratio between Ta in Ta_2O_5 film (Ta*) and Ta in unformed anode (Ta), was calculated using anode weight increase during formation. Figure 5a shows

Ta*/Ta and CV/g with 50k CV/g powders as a function of formation voltage. Figure 5a also shows efficient CV/g*, which is a product of Ta*/Ta and CV/g.

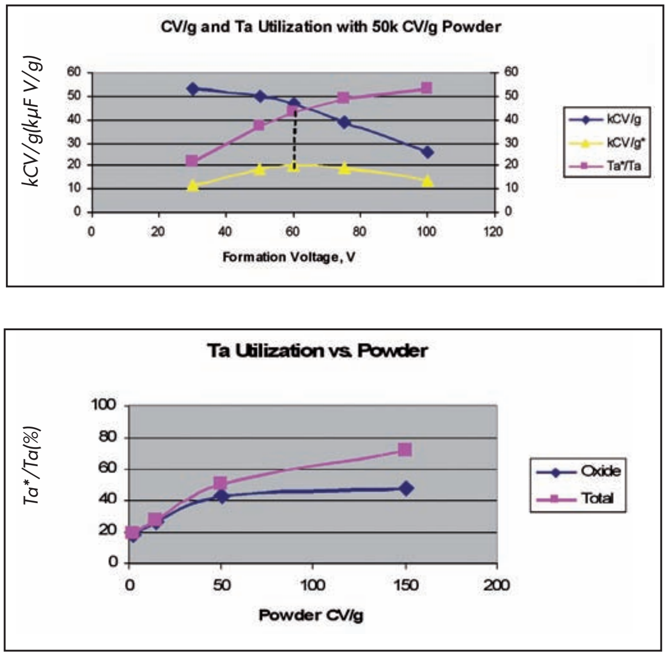

Figure 5: Utilization of tantalum in anodes with 50k CV/g powder (a) and different powders (b)

As can be seen from figure 5a, efficient CV/g* reaches a maximum for Ta*/Ta of about 40%.

Similar analysis was performed with different tantalum powders. Figure 5b shows tantalum consumption in Ta_2O_5 film (oxide) and combined oxide and 10 nm plate (total). According to figure 5b, tantalum consumption in tantalum anodes with low and mid CV/g powders is equal to or lower than 50%, while other 50% increase anode weight, volume and cost, but do not contribute to the capacitance.

Press density (d) and sintering temperature (Ts) of tantalum anodes are the two major parameters that can be used to improve utilization of tantalum powder in tantalum capacitors. As an example, figure 6a shows CV/g as a function of d and Ts with 23 CV/g powder.

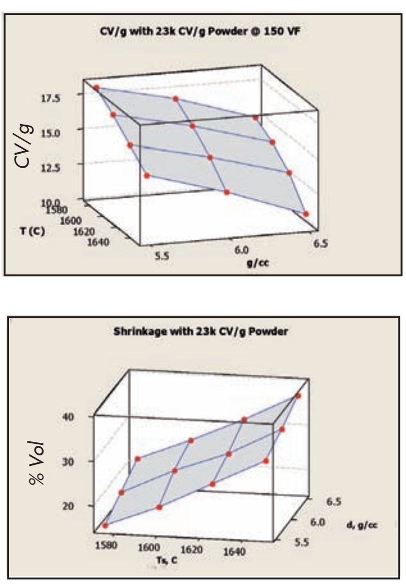

Figure 6: CV/g (a) and shrinkage (b) in anode with 23 k CV/g powder, as a function of press density and sintering temperature

According to figure 6a, CV/g rolls down with the increase of both d and Ts. This reflects increased shrinkage of tantalum anodes with increasing d and Ts (figure 6b).

At the same time, reducing d and Ts results in thinner 'necks' between powder particles and, thereby, steeper CV rolling down and DCL increase at higher formation voltages (figure 7).

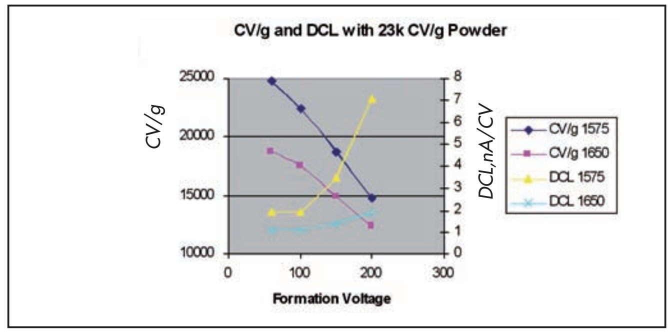

Figure 7: CV/g and DCL in anode with 23k CV/g powder as a function of formation voltage

CV/cc of tantalum anode sintered with 23k CV/g tantalum powder as a function of press density and sintering temperature is presented in figure 8.

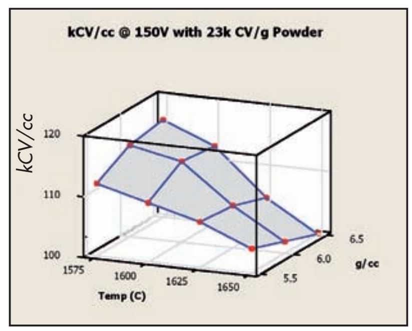

Figure 8: CV/cc in anodes with 23k CV/g tantalum powder as a function of press density and sintering temperature

Figure 8 shows that there is a possibility of increasing CV/cc at high press density and low sintering temperature. However, with conventional sintering in vacuum, low sintering temperature does not provide sufficient bonding between the powder particles, affecting mechanical and electrical properties of the sintered anode. This is due to oxygen, which dissolves in the tantalum particles from the natural surface oxide during sintering in vacuum and acts as sintering inhibitor.

When sintering is performed in a deoxidizing atmosphere, for example in magnesium vapor, oxygen is removed from the tantalum particles.[3] This intensifies diffusion of tantalum atoms, allowing growth of 'necks' between powder particles at lower temperatures than when sintering in vacuum.[8] Y-Sintering process [8], patented by Vishay, also solves the problem of the powder bonding to the lead wire by a short temperature increase above deoxidizing temperature but below regular sintering temperature.

An alternative process of low temperature sintering in a deoxidizing atmosphere is under development at KEMET.[9] Initial results of this sintering are presented in figure 9 for 50k CV/g tantalum powder. This figure shows CV/cc, oxygen content and delta volume in tantalum anodes sintered in vacuum (Sintering) and sintered in a deoxidizing atmosphere (D-sintering)

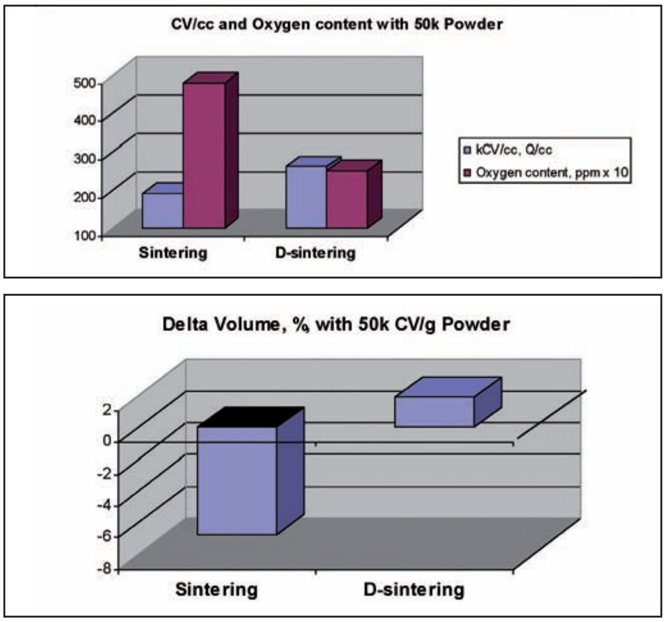

Figure 9: CV/cc, oxygen content (a) and delta volume (b) in anodes with 50k CV/g powder

As can be seen from figure 9a, D-sintering provides about a 35% increase in CV/cc and radical reduction in oxygen content in sintered anodes compared with those sintered in vacuum. Increase in CV/cc with D-sintering relates to anode expansion, while sintering in vacuum results in anode shrinkage (figure 9b). This difference in volume change between regular sintering and D-sintering is caused by a change in the dominant sintering mechanism. When sintering in vacuum, the dominant sintering mechanism is bulk diffusion of tantalum atoms, which results in mutual penetration of the powder particles and, thereby, in anode shrinkage. With low temperature D-sintering, the dominant sintering mechanism is surface diffusion of tantalum atoms. When tantalum atoms flow on the surface of tantalum particles, they build up 'necks' between the particles, leaving open pores and expanding the anode volume.

Low oxygen content in D-sintered anodes also results in low density and small size of initial crystals on the anode surface. This helps suppress crystallization of the anodic Ta_2O_5 film, providing low and stable DCL to the finished parts. These conditions allow reduction in form-factor and, thereby, additional increase in volumetric efficiency of tantalum capacitors.

CONCLUSION

Combining the package of crystallization preventing techniques with breakdown simulation screening provides tantalum capacitors with low and stable DCL and outstanding reliability despite the fact that the dielectric in these capacitors is very thin and thermodynamically unstable. When D-sintering of tantalum anodes is added to the package, tantalum capacitors demonstrate high stability, reliability and volumetric efficiency, which are critical for most applications, especially those in medical, military and aerospace fields.

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MINING IN NIGERIA – MEKIOS AND TIN SHEDS

This article was prepared from the paper by Sele Obomhense of Mekios Ltd, presented at the meeting of the T.I.C. held in Rio de Janeiro, Brazil, in October 2007.

INTRODUCTION

Mekios Limited is a mining and exploration company operating in Nigeria. It has a number of licences that cover prospective areas across the country. Mekios has a field team of qualified geologists and field assistants, supported by the detailed local knowledge of artisans. It also has qualified analytical chemists who are monitoring columbite-tantalite concentrates and providing field support. It is the company's intention to develop a modern processing plant to upgrade artisanal production and also material mined from its licence areas. This work is fully supported by the Ministry of Solid Mineral Development whose local representatives have had an advisory role in local projects. Nigerian Banks, operating the government's mineral development policy, are financially supportive of Mekios Mining.

For those unfamiliar with Nigeria, it is a large country in West Africa extending over 923 768 km^2 (nearly twice the size of France) that is underlain by geology ranging from Archean (more than 2500 million years old) to present day sediments (figure 1). In the 'minerals' sector, oil and gas have dominated the industry, so much so that little has been done in the mining sector for decades. The Government of Nigeria aims to remedy this and has policies in place and a designated Ministry, the Ministry of Solid Mineral Development. It has also recently revised its mining laws to encourage investment in the sector.

Figure 1: Map of Nigeria

Africa has always had a dual image: it has been relied upon as an additional source in times of shortage and, at other times, criticised for the production of columbite-tantalite, particularly in 2000 when columbite-tantalite was reported to be fuelling the civil war in the Congo, Rwanda and Burundi. In terms of columbite-tantalite production, Nigeria has also been an unknown quantity and this paper sets out the current state of the industry and how Mekios plans to develop the industry into a formal, regulated and organised state that meets international standards.

A VERY BRIEF GEOLOGY OF NIGERIA

Nigeria is underlain by metamorphic rocks and granitic intrusions of the pan-African series resulting from continental collision. Lying on these rocks are a series of sediments of the Benue Trough that is marked by the Niger and Benue Rivers and the Niger delta, host to Nigeria's oil and gas reserves. The pan-African orogeny took place over a period of time, about 650-450 million years ago. It caused pronounced deformation of the existing geology and remobilisation of the minerals and elements within them. This orogeny has overwritten an older geology and it is certain that the basement rocks (transformed by the orogeny) have been affected by previous polycyclic events yet still retain remnants of geology dating back about 3000 million years. Much later, shortly after the age of the dinosaurs, earth movements caused the stretching of the crust as part of the precursor to the Atlantic opening. This caused thinning and rifting in a tensional environment including the development of the Benue Trough[1].

These events have a bearing on the distribution of tantalum and niobium. The reworking of the basement allowed the differentiation of those elements, such as tantalum and niobium, that are termed 'incompatible' (that is they are not rock-forming minerals), allowing them to be 'left over' in pegmatites and similar rocks. Tensional regimes are required to raise tantalum and niobium from deep in the crust (figure 2).

Figure 2: Outcropping rocks

The tantalum-niobium industry in Nigeria is estimated by the United States Geological Survey to produce 100 tonnes per year of columbite-tantalite concentrates. If the number of processing plants in operation is estimated at five (and there may be more), this gives an annual output for each plant of 20 tonnes, or less than 0.5 tonne per week. Tin Sheds, such as the one illustrated in figure 5, have a concentrate production of 0.5 tonne per day, we believe, in the dry season, and consequently the scale of production is much greater than published, making the USGS figure a considerable underestimate.

ARTISANAL MINING

The columbite-tantalite minerals are recovered by miners working mainly alluvial deposits in the streams and rivers in the western and central part of Nigeria. Hand digging and simple panning are the principal methods of recovery. The artisans, although not trained in any sense of the word, are skilled in identifying those sections of rivers and streams that are likely to trap the heavy minerals including columbite-tantalite. As the great majority of columbite-tantalite is recovered from small streams by panning and washing, thus requiring copious quantities of water, most artisanal mining takes place during the wet season, which is also the main agricultural planting season. It is therefore a balance between columbite-tantalite digging and agriculture, the former providing cash whilst the latter is essential for life. When the price of columbite-tantalite rises above its usual level, as we saw in 2000, the price paid by the treatment plants also rises and the balance tips in favour of mining. When the price falls, the relative values of farming and mining become finely balanced. This accounts for the great swings in the amount of columbite-tantalite produced from West and Central Africa.

The techniques of recovery are simple. Spades, buckets, bowls and pans are used to upgrade stream-dug gravel into a concentrate. Washing, that is stirring the gravels, sands and clays from the river to remove the clays and fines that prevent the concentration of the heavy minerals by panning, effectively sizes the concentrates (figure 3). Most minerals recovered are in particles larger than 1mm, when columbite-tantalite is easily visible to the naked eye and can therefore be upgraded into a high-grade concentrate. Often during the height of the wet season the flow of water prevents access to some gravels in the stream or river. These are revisited when water levels subside to gain what was not accessible in earlier work. There is no flow in many of the smaller streams during the dry season and recovery is not possible without transporting water, often considerable distances, and hence mining is not economic for the effort involved. This happens at a time when subsistence agriculture is also at a low level.

Figure 3: Artisanal mining

There is little hard rock mining of columbite-tantalite (or any other minerals) by artisanal miners as they do not have suitable equipment. For example, at our Bishewa exploration licence area there is a pegmatite vein outcropping over several hundred metres (figure 4). It is apparent that higher grades of columbite-tantalite are visible in the margins and at the base of the pegmatite and we have undertaken mining to help fulfil our overseas orders. Within the Bishewa licence are several hundred pegmatites with concentrations up to 5000 g/t Ta_2O_5. Most are hard rock with little alluvial material, but some high grades have been mined where minerals are visible. We have suffered from illegal mining but owing to our good relations with the local villagers, who help us with our exploration programme, we have been able to secure the site. We are also planning to bring in mechanised mining to extract the whole of the pegmatite. However, to grow our business, we are concentrating on bringing forward plans to improve the method of collection, the processing and the quality control of columbite-tantalite concentrates from artisanal miners.

Figure 4: Hard rock

As a first step, we have established a purchasing team in Jos and have retained premises for the blending and storage of columbite-tantalite concentrates prior to shipping. Most of these concentrates have either been purchased from 'Tin Sheds' or directly from artisans and upgraded in these establishments.

TIN SHEDS

The term 'Tin Shed' is not a reference to what the sheds are made of but describes their original purpose (figure 5). In the Jos region of central Nigeria there are extensive outcrops of late-stage granites that are rich in elements such as uranium, tantalum, niobium and tin. Often these granites are weathered and metasomatised to a certain depth, and it was this material that used to be mined and taken to the Tin Sheds for processing. After alluvial deposits were hand-dug, the principal method of recovering tin was by gravity (essentially panning) followed by magnetic separation. Many of these heavy minerals have slight differences in magnetic attraction and it is possible to upgrade to a near monomineralic concentrate. The collapse of the tin market, mainly bought about by large quantities of Brazilian tin entering the market, forcing the LME to abandon its price support, was the final fatal blow to the Nigerian tin industry. Enterprising as ever, the Tin Sheds turned to columbite-tantalite processing.

There is a wide spectrum of sources of columbite-tantalite in Nigeria. For example, in the south west states, pegmatite rocks contain more tantalite than columbite, and often the tantalum occurs in finer grain sizes. In the granite domain of central Nigeria much of the columbite-tantalite is dominated by niobium minerals in ratios similar to those found in apogranites such as Pitinga in Brazil and Ghurayyah in Saudi Arabia. Mekios intends to support the industry by collecting artisanal concentrates on site and to improve their recovery by encouraging artisanal miners to sell directly to Mekios concentrates that contain more of the finer–grained material that is currently lost at site, that is, less panned material. Mekios has invested in portable XRF analytical equipment for this purpose, so that the artisans, who are fully aware of the content of their coarse concentrates, can compare the analytical results and prove the validity of the elemental reading in relation to less-processed finer material.

By applying a little science it is possible to raise productivity, and benefit those at the sharp end of operations. It is not our intention to displace current operations but to improve them. The Tin Sheds are very effective in recovering columbite-tantalite, despite appearances. Throughout Nigeria local artisans have the skill to mend, modify and maintain equipment that would have long since been abandoned elsewhere.

Figure 5: Tin Shed

In a typical Tin Shed the artisanally-produced columbite-tantalite concentrate is sieved to an appropriate grain size and passed through a cross-belt magnetic separator. The machine illustrated in figure 6 was built in Birmingham, UK, in about 1955. Other equipment of a similar age is common, including a hand-built oil-fired roaster and an electrostatic separator built in the U.S.A. The function of the roaster is not the usual oxidation of sulphides but to break down the rock into mineral components without crushing.

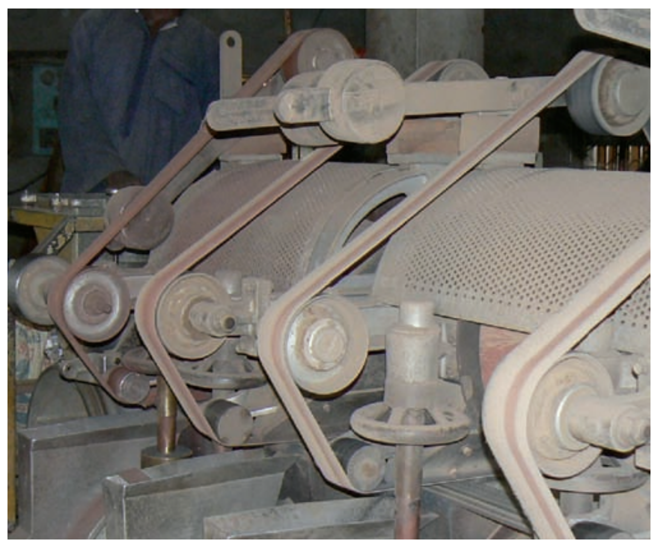

Figure 6: Cross-belt magnetic separator

CONCLUSION

Nigeria is highly prospective for tantalum and niobium both in pegmatites and in granite-related large volume deposits. Most exploration took place in the colonial era and consequently modern methods will undoubtedly reveal new columbite-tantalite and other mineral deposits. Mekios intends to be at the forefront in an exciting time for the Nigerian mining industry.

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MEMBER COMPANY NEWS

Peter Maden

The Tantalum-Niobium International Study Center was very sad to learn that Mr Peter Maden, retired from Vishay Sprague, had passed away suddenly on January 28th.

Mr Maden graduated from the University of Massachusetts with a degree in Chemical Engineering. He began his 35 year career with Sprague Electric Company (later Vishay Sprague). He held many senior technical and management positions in the company including vice president and general manager of the Sprague Tantalum Capacitor Division.

He was a long-standing member of the Executive Committee of the T.I.C. and was President of the association from 1993 to 1994. His contribution to the association's activities was highly valued and greatly appreciated.

Peter Maden spent all of his working life in the tantalum capacitor field and will be long remembered in the industry.

Commerce Resources

Commerce Resources has announced that results of its 2007 diamond drilling program have expanded the known tantalum and niobium mineralisation at the Upper Fir deposit. The deposit is located in British Columbia and is wholly owned by the company.

During 2007, 18 HQ sized drill holes totalling 4710 metres were completed at the Upper Fir deposit. All 18 holes intersected mineralised carbonatite, thereby extending the known mineralisation by an additional 250 metres to the south and 200 metres to the east of the area identified in 2006.

When combined with the apparently contiguous Bone Creek occurrence (drilled in October 2005), the Upper Fir carbonatite complex now extends approximately 800 metres east-west by 1400 metres north-south. The Upper Fir carbonatite remains open to both the east and to the south.

President of Commerce Resources David Hodge comments: 'We are very excited by these results because they not only show an increase in the size of the Upper Fir Carbonatite, but also the discovery of zones of enriched grades of tantalum and niobium. These results point to an extension of the potential life span of this project. Our primary direction is the focus on the development of this near surface deposit, although we will continue our exploration of the other Blue River carbonatites under claim.'

Production is expected to start in 2010.

Danfoss Tantalum Technologies/Tantalum Technologies A/S

On January 01 2008, Danfoss Tantalum Technologies changed name to Tantalum Technologies A/S.

Dr Bo Gillesberg remains the nominated delegate to the T.I.C. His new e-mail address will be, from May 01 2008, bg@tantaline.com.

Gippsland Ltd and H.C. Starck GmbH

Gippsland Ltd has secured a ten year offtake agreement through its 50% owned subsidiary Tantalum Egypt JSC with H.C. Starck GmbH for the supply of tantalum pentoxide from its Abu Dabbab project in Southern Egypt.

Under the offtake agreement, H.C. Starck will receive 600 000 lbs of Ta_2O_5 per annum - almost the entire expected initial annual production of Ta_2O_5 from the project.

Gui-Family Tantalum-Niobium Ltd

Gui-Family Tantalum-Niobium Ltd has a new e-mail address: vivisalan@126.com.

Hi & M Corporation Co.

We have been advised of new contact details for Hi & M.

Address: 102 Arbre Ogikubo, 2-4-13 Amanuma, Suginami-ku,Tokyo 167-0032, Japan

E-mail: hiandm@hiandm.co.jp

Tel.: +81-3-3391-8750, Fax: +81-3-3391-8751

Iamgold/Camet Metallurgy Inc.

Mr Claude Dufresne, nominated delegate to the T.I.C. for Iamgold has informed us of the following: 'The marketing department of Iamgold has been transferred into a new company named Camet Metallurgy Inc. Camet will be maintaining the same responsibility as before i.e. the marketing and sales of Niobec ferroniobium, and will maintain a partnership with Camet Metallurgie GmbH.'

We have been advised of new contact details.

Address: Camet Metallurgy Inc., 4300 St-Ambroise Street, Suite 101, Montreal, Quebec, Canada H4C 3R3

E-mail: c.dufresne@camet.ca

Tel.: +1 514-932-9993, Fax: +1 514-932-1543

Sanyo Electric Co.

The nominated delegate to the T.I.C. for Sanyo Electric Co. is now Mr Hiroya Nishimoto, General Manager, Capacitor Division Engineering Department.

E-mail: hiroya.nishimoto@sanyo.com

AS Silmet

Silmet has appointed Anti Perkson as director general of the company from January 2008.

He replaces Tonu Vetik who has been director general of the company since 2005. Tonu Vetik will leave the company to focus on other projects.

Anti Perkson has worked with Silmet as head of product development since 2003 and as research and development director since January 2007.

H.C. Starck GmbH and H.C. Starck Ltd.

The nominated delegate to the T.I.C. for both H.C. Starck GmbH (Germany) and H.C. Starck Ltd. (Japan) is now Dr Karlheinz Reichert.

E-mail: karlheinz.reichert@hcstarck.com

Talison Minerals

Please note new contact details for Talison Minerals.

Address: Level 4, 37 St George's Terrace, Perth, Western Australia 6000

E-mail: marketing@talison.com.au

Website: www.talison.com.au

Vishay Sprague

The nominated delegate to the T.I.C. for Vishay Sprague is now Mr Yehuda Hogeg.

E-mail: yehuda.hogeg@vishay.com