BULLETIN N° 115
ISSN 1019-2026

T.I.C.

TANTALUM-NIOBIUM INTERNATIONAL STUDY CENTER

PRESIDENT'S LETTER

Our meeting in Lisbon promises to be well attended, and we are looking forward to an interesting technical session covering a wide range of topics. My company, EPCOS, is busy planning the tour of our capacitor plant at Evora. A fascinating programme of sightseeing will complete the field trip.

The gala dinner at the Carriage Museum in Lisbon is certain to be a memorable event – this is truly an exceptional setting for our banquet.

After almost thirty years of existence, the association has established its own traditional pattern for the annual conferences, and yet every year there are changes as the industry evolves to meet its challenges. Each gathering has a unique character and a flavour of its own, partly depending on the place in which the meeting is held, of course. We try to rotate the venues through the regions of the world where tantalum and niobium are found and used, holding meetings in Europe, Asia, North and South America and Australia.

The year of my Presidency will end with this Assembly, and I have to say that the time has passed extraordinarily quickly. It has been a privilege to preside over the association for the past twelve months.

Josef Gerblinger
President

CONTENTS

http @
www.tanb.org
e-mail to info@tanb.org

LISBON, OCTOBER 12TH-14TH 2003

The Forty-fourth General Assembly of the Tantalum-Niobium International Study Center will take place in Lisbon on Monday October 13th as part of a meeting from October 12th to 14th, based at the Hotel Le Meridien Park Atlantic.

On Sunday October 12th the registration desk will be open during the day. A cocktail reception to welcome everyone to the meeting will be held in the hotel from 6p.m. to 8p.m.

On Monday the day will begin early with the business of the association to be carried out at the General Assembly of the members. Following a coffee break the technical session will open, continuing until 5p.m., with a pause for lunch.
The papers planned for the technical programme, with abstracts, are listed below.

In the evening all the participants will go to the Carriage Museum for the gala dinner, sponsored by EPCOS and the T.I.C. This will be a magnificent place to hold a unique event, as the tables will be set amongst the splendid exhibits in the historic former riding school.

On Tuesday October 14th EPCOS will offer a plant tour of its capacitor facility at Évora. There will also be a sightseeing tour in the region, and those not taking the plant tour will be able to take a sightseeing trip for the whole day.

TECHNICAL PROGRAMME

Review of the year

by C. Edward Mosheim, Technical Promotions Officer, Tantalum-Niobium International Study Center

An outline of the T.I.C. data collection system and its rules will be given. Statistics and estimates, as available, will be discussed, with charts where possible.

News of companies and the industry over the year which has passed since the last General Assembly will be summarised, covering topics such as ore production, new mining projects, technological advances, changes in company facilities, sales by DLA/DNSC.

Tantalum capacitors – challenges and developments

by Philip Lessner, John Moore and John Prymak, Kemet Electronics, to be presented by Mr John Moore

The past five years have seen an erosion of tantalum capacitor market shares, beyond overall market decline. Challenges facing this device as the market recovers include perceptions of limited supplies or future restrictions impacting cost and availability, as well as concerns over failure modes. Additionally, the growth of niobium based capacitors is adding to these concerns as this alternative emphasises that it holds solutions to all of these concerns, at reduced pricing. Developments for tantalum capacitors must emphasise better performance, reliability, and a more benign failure mode to address the niobium challenge. The manufacturers and ore suppliers must show where the supply issues of the past have been addressed, and how they can be flexible to market demands in the future.

Tantalum industry in China

by He Jilin, Zhang Zhongguo, et al., Ningxia Orient Tantalum Industry Corporation, to be presented by Ms Guo Hong

This paper will describe the tantalum industry in China, including mining, processing, capacitor manufacturing, major players, and tantalum related electronic markets. Prospects for the future development of this industry in China will also be discussed.

A comparison of niobium, niobium oxide, tantalum and aluminium capacitor technologies

by Dr T. Zednicek, Dr Z. Sita, Dr C. McCracken, S. Zednicek, W. Millman and J. Gill, AVX, to be presented by Mr William Millman

The electronic design engineer has never had a wider choice of capacitor solutions for his circuit needs. Recently, new capacitor technologies have been introduced into the market, searching to achieve the best compromise between performance, size, reliability, availability and cost.

To understand better the relative performance of these new technologies, this paper will present comparative performances in typical customer circuits that have established or traditional capacitor solutions and contrast the benefits. Additionally, the paper will look forward in identifying key drivers in the technology and likely developmental road map, and its impact on capacitor material developments.

With pick and pan – mining and processing of tantalum ores

by Richard Burt, GraviTa

A tantalum particle passes through many stages on its journey to become an integral part of a computer: some are low-tech, others high-tech, requiring complex processing and equipment in increasingly sterile conditions. But it all starts, literally, in a 'hole in the ground', with the winning and separation of the tantalum minerals from their host rocks.

This paper briefly reviews the major localities where tantalum is found, where it is mined, and the various minerals and ore types of both current and potential future importance. The paper will then focus on the mining and mineral processing technologies that are currently applied to the upgrading of the ore to a mineral concentrate suitable for the next stage in the supply chain – chemical processing. It will also discuss the 'next generation' mines, the different technologies that may be required to unlock their wealth, and some of the potential constraints to their development.

New developments in conductive polymers for capacitors

by Dr Klaus Lerch, Dr Udo Merker, Dr Klaus Wussow, Dr Stephan Kirchmeyer, H.C. Starck GmbH, to be presented by Dr Klaus Lerch

The demand for capacitors with low equivalent series resistance (ESR) and high capacitance is growing fast. The ESR of the electrolytic capacitors has been dramatically reduced by the introduction of conductive polymers over the past few years.

Because of its high conductivity and temperature stability the conductive polymer polyethylene dioxy thiophene (PEDT, Baytron) is widely used in the capacitor industry. Besides optimised materials, new polymer processes are necessary to allow efficient and cost-saving manufacturing of low ESR polymer capacitors.

Chemical oxidative polymerisation is an effective way to build up a conductive polymer in porous capacitor anodes. H.C. Starck is proud to introduce a newly developed process based on PEDT which shows distinctive advantages such as:

- Cost efficient process with almost no material loss due to stoichiometric polymerisation
- Efficient impregnation of high CV tantalum anodes within only a few cycles
- Low ESR values and low leakage currents

Detailed results illustrating the aforementioned advantages are presented in this paper.

Niobium for capacitor applications in Brazil

by Solon Y. Tagusagawa and Alberto A. Ono, Companhia Brasileira de Metalurgia e Mineração, and Masana Imagumbai, CBMM Asia

Since the development of the tantalum capacitor there has been interest in developing niobium as an alternative metal. Attempts to manufacturer niobium-metal capacitors began as soon as the material became available commercially in the 1960's. Niobium exhibits a higher oxygen solubility than tantalum, and it is not so easy to produce a thermally stable oxide film. Furthermore, in the past the chemical purity of niobium powder was not as good that of tantalum powder, which contributed to the poor dielectric properties. New techniques for niobium metal powder production and for niobium capacitor manufacturing have completely changed this scenario. Several capacitor manufacturers have already announced, and are offering, niobium capacitors of almost the same quality as tantalum capacitors for some applications.

CBMM started research and development on niobium metal powder and wire for capacitor applications a few years ago. Two main routes are being pursued for powder production: the milling process (hydriding of high purity niobium ingot, milling, and de-hydriding) and the reduction process (magnesium or calcium reduction of niobium compounds). This paper discusses recent results on the manufacture of high quality niobium metal powder and of niobium metal wire for capacitor applications.

Niobium in crystal ware

by A.T. Pereira and A.D. Menezes, Companhia Brasileira de Metalurgia e Mineração, and F.W. Strauss and D. Silva, Cristallerie Strauss, to be presented by Mr Antonio Telhado of CBMM

Niobium crystal ware is attracting much attention since it is suitable for the manufacture of high-quality glasses for the table and other household articles normally made of lead crystal. Formulation of niobium crystal ware includes the use of other chemical compounds in order to stabilise the crystal lattice. Modifications in the engineering techniques with reference to oven temperatures, fusion time and kilning the molten mass have been made. Leaching, refractory index and thermal expansion analyses have been carried out, showing that the best results were obtained with a formulation of 4wt% of Nb_2O_5. Niobium crystal ware is highly resistant to corrosive media, even to dilute hydrochloric acid. It is environmentally friendly and harmless to health. Niobium crystal exhibits workability at moderate temperatures and can be cut and polished, giving it a pleasing bright appearance.

Future of tantalum capacitors – technologies and markets

by Dr Werner Lohwasser, EPCOS SA, Portugal

The world's tantalum market is facing the most severe turn-around in its history. Different technologies are attacking the tantalum market and trying to substitute their products for tantalum. Although the tantalum capacitor was often said to be a phase-out device in the past, new technologies covering the highest CV and lowest ESR values will drive tantalum capacitors out of their current pessimistic situation. An update on different technologies for tantalum capacitors will be given and their future potential discussed. The choice of markets and applications to be addressed which will give a promising future for tantalum capacitors will also be considered.

Tantalum chip capacitors in the automotive arena

by Martin Rudert and Axel Sterzl, Robert Bosch GmbH, Automotive Electronics Division

In 1985 the share of production value of an average car taken by electronics was less than 5%. In the year 2005, we expect that share to be above 20%. The growth in demand for automotive electronics affects the producers of tantalum capacitors and consequently their suppliers.

H.C. STARCK INC

The History of H.C. Starck Inc, Newton, Massachusetts, U.S.A.

Information was recently received from Dr. Christopher J.B. Fincham, former Executive Vice President of NRC, Inc concerning the history of the operations at Newton, Massachusetts, a company with its beginnings in 1940. We are pleased to bring you this detailed history of a company from the early days of the tantalum and niobium industry which is still important today.

Richard S. Morse, a young physicist, convinced William A. Coolidge, an investor, that vacuum technology represented a very significant process technology for the future. Morse, with the major funding share from Coolidge, established National Research Corporation in Boston, Massachusetts, moving later to Cambridge. Vacuum processes were developed for the coating of lenses, metalizing of plastics and paper, the manufacture of instant coffee and the production of frozen orange juice concentrate. Profits from the sale of these technologies financed further development of process technologies and applications.

National Research Corporation also developed a line of vacuum equipment, with items such as diffusion pumps, vacuum gauges, and valves, resulting in the formation of an Equipment Division, with facilities in Newton. This became the headquarters and manufacturing facility.

In the early 1950s, there was a demand for metals of higher purity and improved properties. A major breakthrough was the vacuum arc-melting of superalloys for jet engines and other military and industrial applications. Interest in titanium for use in ships, aircraft, the chemical industry, and other applications where high strength and corrosion resistance were required, provided a new opportunity. A drawback to the use of titanium was its reaction with oxygen and nitrogen when heated in air. Vacuum arc-melting controlled the concentration of those elements in products, though was somewhat limited by the concentrations of oxygen and nitrogen in the feedstock metal derived by the magnesium reduction of titanium tetrachloride (Kroll Process).

Attention was focused on new processes for production of the titanium metal itself. The 'Torch' process – feeding liquid sodium and gaseous titanium tetrachloride through concentric nozzles to form liquid titanium – resulted in occasional explosions, equipment failures, and erratic performance. This approach, a joint development project with Monsanto, was abandoned.

However, the sodium reduction of titanium tetrachloride in molten sodium chloride was a successful approach. Large Inconel vessels were built to contain this reaction. A similar method was also successfully used to produce zirconium metal from zirconium tetrachloride.

In the early 1950s, the titanium pilot plant was used for production trials of tantalum powder by the sodium reduction of potassium tantalum fluoride in molten sodium chloride. In 1957, a decision was made to go into tantalum powder production. The traditional uses in medical and corrosion resistant applications were predicted to be overshadowed by the use of tantalum as foil and sintered-powder slugs in wet capacitors, based on the excellent dielectric properties of the oxide film on the metal. The applications were for military electronics. Initial production capacity was 25 000 pounds per year. The facility for the production of tantalum was located in Cambridge, Massachusetts.

The sintered powder slug market advanced rapidly in comparison to the foil requirements. The production of capacitor quality foil by toll conversion at outside mills was not successful, so the company focused its efforts on powder.

The year 1958 saw the successful introduction of a sodium-reduced tantalum powder, designated SGN, with a capacitance of about 2000 CV/g (sintered at 2150°C for 30 minutes), to be followed by SGP powder with a capacitance of 2500 CV/g. Both products were significantly better than the powders of competitors, notes the company, especially in consistency of quality. As the demand for these powders grew, a new facility was built in the former titanium pilot plant in Newton.

Since NRC had no facilities to produce potassium tantalum fluoride, the management contracted with Mallinckrodt in St

Louis, Missouri, to provide that feedstock. Mallinckrodt purchased raw materials in the form of ore concentrates and produced potassium tantalum fluoride and niobium oxide. The niobium oxide was sold to the alloy industry for the production of ferro- and nickel-niobium.

As the demand for tantalum in mill products grew, tantalum ingots were produced by arc melting and then converted to sheet, rod, wire, and tubing by outside conversion companies. Fabricated tantalum products were also produced for furnace parts, crucibles, bayonet heaters, thermowells, and patch kits for glass-lined vessels. The chemical industry was the primary market with tantalum required for highly corrosive environments.

The Metal Division was established as a separate business within NRC in 1959. It was about this time that the founder, Richard Morse, became Assistant Secretary of the Army for Research and Development in Washington, D.C. and left the company.

The 1960s saw the growth of the tantalum capacitor industry especially between 1965 and 1970 when sales of capacitors grew from 134 million to 540 million units. The market in the U.S. was the largest, but during this period the industry also developed and grew in Europe and Japan with these regions having market shares of 34 and 11% respectively in 1970. The development of the tantalum capacitor industry and market requirements for metallurgical products led to the opening of sales offices in Geneva, Switzerland, and a distributorship with Vacuum Metallurgical Corp. in Tokyo, Japan. The mill products business required the use of toll converters since NRC had no rolling mills or wire drawing facilities. Fabrication of specific equipment from tantalum was generally done in-house for such products as bayonet heaters, crucibles, sintering furnace components, etc. Sales offices were opened in Massachusetts, New Jersey, Illinois, and California.

In 1962, the Metals Division purchased a building in Newton, at 45 Industrial Place, and consolidated all of its operations there, moving them from Cambridge. In 1963, the Norton Company, a dominant company in the abrasives business, acquired NRC.

The early 1960s also saw the development of ingot powders that brought superior performance to high-voltage applications. The first product was designated SGQ and was produced from arc-melted ingot. This product was of lower capacitance level than sodium-reduced powders and was more difficult to use in the pelleting process for anode construction. Another sodium-reduced powder developed in the early 1960s was SGP-4, which exhibited a typical capacitance level of 4500 CV/g.

All of these early powders were controlled blends of various particle sized powders aimed at specific capacitance requirements.

Agglomerated powders were introduced in 1969 and these products addressed the negative characteristics of (a) poor flow behavior, and (b) difficulty in pressing an anode. SGPR and SGQR type powders became industry standards going into the 1970s.

The Norton Co. eventually sold off some of its acquisitions in 1971, including the Research Division, the Vacuum Equipment Division, and others, but a buyer for the Metals Division was not found. After an unsuccessful attempt to sell the tantalum operations to Wah Chang, a buyer was found in Hermann C. Starck in Goslar, Germany. An agreement was reached in 1976 for a 50/50 partnership between Hermann C. Starck and Samincorp in New York, the latter being a subsidiary of South American Consolidated Enterprises. Samincorp was a trading company that dealt with specialized materials, including tantalum ores. The new company was incorporated under the name NRC, Inc. as an independent company with equal shares of representation on the Board of Directors.

Powder development activities centered on the goal of increasing the unit capacitance without sacrificing other physical, chemical and electrical parameters. The process variables of the sodium reduction process, specifically, reduction temperature, stirring rate, and dilution ratio of the sodium chloride and other diluent salts, were studied to increase the yield of higher surface area powder and narrow the distribution of particle sizes.

The first powders resulting from these efforts were SGV and SGVR (agglomerated) with capacitance levels of 6000 to 8000 CV/g. They were introduced to the market in 1972. The next powder series was SGZZ and SGZR that were introduced in 1976 with a capacitance range of 10 000 to 12 000 CV/g.

Grain-stabilized arc-melted tantalum (developed in the 1960s) by doping with yttrium resulted in a successful line of metallurgical products that were represented by furnace hardware, sintering trays, and other high temperature products, including tantalum wire.

The capacitor market in the U.S. grew to 700 million units in 1978 with the resulting increase in sales of powder and metallurgical products.

The 1980s brought more change with the purchase of 94% of the shares of H.C. Starck KG in 1983 by Bayer AG, a giant German chemical and pharmaceutical company, with the remaining 6% of the shares purchased in 1993. H.C. Starck thus became a wholly owned subsidiary of Bayer AG. Bayer operated in the U.S. through its subsidiary Miles, Inc. NRC, Inc. was owned 50% by Miles, Inc until Miles purchased the remaining 50% of the shares in 1987 resulting in 100% ownership by Miles, Inc. In 1996, Bayer AG bought back the right to its name in the U.S. and Canada by purchasing part of the business of Sterling-Winthrop (a subsidiary of Smith Kline Beecham PLC) which owned the Bayer name in North America. The H.C. Starck group is 100% owned by Bayer today.

The 1980 to 1990 period saw the expansion of facilities with the purchase of adjacent buildings in Newton. The focus was on space for equipment and capacity for metallurgical products. NRC purchased the wire production facilities of Fansteel when that company left the tantalum business in 1989, including the bar sintering furnaces from the Muskogee, Oklahoma plant and wire drawing facilities in North Chicago, Illinois. The equipment was gradually moved to the plant site in Newton.

The technology of tantalum powders was rapidly changing with the continuous demand for higher and higher surface area products. The smaller particle diameters also demanded lower sintering temperatures so that removal of impurities during sintering was significantly reduced. Oxygen embrittlement of the anode wire became more severe. The development of deoxidation technology on tantalum powder resulted in the

production of ZRD powder with a nominal capacitance of 12 000 CV/g.

In 1985, H.C. Starck expanded its production facilities for potassium tantalum fluoride and began to supply NRC Inc. with 100% of its requirements.

The V-Tech company was formed in 1984 with five owners: the goal was to become a major supplier to the market in Japan. Two of the owners, namely Vacuum Metallurgical Co. and Colombian Enterprises, sold their shares to Fansteel, one of the other owners, giving Fansteel 51% control of the corporation. The name was changed to V-Tech Fansteel. This company built a tantalum powder production facility in Mito, Japan. When Fansteel exited the tantalum business in 1989, H.C. Starck was able to purchase the company, in 1990. The company now was composed of three production sites, namely, Goslar, Germany; Newton, Massachusetts; and Mito, Japan.

The three locations shared technology for process and product development for improved tantalum powders for capacitor applications.

The Starck/Newton facilities introduced the next generation of powders with capacitance levels of 17 000 and 23 000 CV/g in 1994, designated 'NH175' and 'NH230', respectively. One year later, the company marketed a new series of tantalum powders, designated as NA types with capacitance levels of 30 000, 50 000, and 70 000 CV/g. These high surface area products are in normal use in the capacitor industry today. The technological change continues to drive the surface area requirements for tantalum powders into the 21st century. The miniaturization of electronic systems, high reliability requirements, and the development of high surface area tantalum powders to meet the needs of the circuitry requirements has kept this company and the industry in the forefront of technological change.

Reference: This article was written by C. Edward Mosheim from 'A History of the H.C. Starck U.S. Tantalum Operations', prepared for H.C. Starck, Inc. by Dr. Christopher J.B. Fincham, Former Executive Vice President of NRC, Inc. currently Fincham Associates Management Consultants; December 1998.

IN THE EARLY 1900S

by Mr Ed Mosheim, Technical Promotions Officer of the T.I.C.

The IOM3 Conference in London on January 23rd 2003 provided an opportunity to talk to a number of individuals who were involved in, or were knowledgeable concerning, the mining of tantalum-bearing minerals. Antony Michell told a very interesting story to the conference attendees during the final question and answer session concerning the finding of manganotantalite in northwest Australia by two of his great uncles, both being mining engineers along with his grandfather in the early 1900s. He showed to the audience two examples of the manganotantalite that came from these early adventures in northwest Australia. Further conversation during that evening resulted in my being able to photograph the two specimens. Additional details were supplied by letter dated February 5th 2003, and contained the following information.

'My grandfather and his two brothers, Frank and William Michell, were mining engineers. Frank became a manager of a copper mine in South Australia but fell down a shaft and became a lecturer in ore dressing at the Redruth School of Mines (later merged with the Camborne School of Mines), while William became a mine manager of the New Bala Bala copper mine in NW Australia. William was a keen mineralogist and told the aborigines there that he would pay them for any shiny, heavy, or unusual rocks that they could bring him. They brought him a crystal of tantalite, being very heavy, and he located and staked three claims in 1901. He quickly realized that it was not cassiterite and decided that it was manganotantalite. He sent one sample to the British Museum in London and after six months received confirmation. Over the next four years, he took all of the loose ore on the top of the felspathic lode outcrop which projected as a small hillock at Wodgina.

'He shipped back to England what he had recovered and he and his brothers began attempting to sell some ore, which was difficult. He realized about £0.6 to £0.7 per lb of tantalum oxide (60% plus). From 1905 until his death in 1953 he kept selling from this stock. Demand for tantalite was erratic in those days and he was unable to offload all of his production. Being a careful man he felt that demand for the metal would grow and that in time he would probably obtain better prices so he was happy to sell only sufficient tonnage for his financial needs.

'When he died, in 1953, I was in Tanganyika working on a mine so my cousin (also a mining engineer) had to dig up and sell the remaining tantalite amounting to about 4 tons. This sold for an average of £2 per lb (of tantalum oxide). I should add that after keeping a ready supply of tantalite in his garage he buried the remainder in his garden - partly for convenience and partly for security!

'In all he mined at Wodgina about 30 tons of tantalite.'

A photograph of the two individual crystals of manganotantalite is shown in Figure 1. They were found at Wodgina between 1901 and 1905.

Figure 1: Samples of manganotantalite

The two brothers published a paper in the 'Report of the Royal Cornwall Polytechnic Society' in 1906 entitled 'Tantalum: Its Ores, Detection, Properties and Uses' by Frank H. Michell, C.E., Lecturer, Redruth School of Mines; and W. A. Michell, Assoc. M.M., Manager New Bala Bala Copper Mines, Ltd. North-West Australia.

In the section covering the occurrence of manganotantalite in

northwest Australia, they describe the district as 'consisting of a series of sedimentary and bedded igneous rocks, skirting an extensive granite mass. These sedimentary beds are very much faulted, and have a prevailing dip to the West; they occupy a very rough range of hills which rise a considerable height above the level of the surrounding plains. The sedimentary rocks are pierced by granite and pegmatite veins, which generally form the body (gangue) of the tin and manganotantalite ores. The felspathic lode containing the tantalite is undoubtedly a contact vein. In this vein the manganotantalite is imbedded in the form of grains and rough pseudomorphous crystals. The lode along its outcrop shed a considerable quantity of loose manganotantalite, which was comparatively speaking cheaply returned; but this source of supply is now completely exhausted, and future returns from this district will have to be drawn from the lode at a much increased expenditure.'

GENERAL NEWS

DLA/DNSC

The US Defense National Stockpile Center announced on July 11th 2003 that it had awarded tantalum/columbium concentrates, approximately 450 000 pounds of tantalum oxide contained (370 000 pounds contained tantalum) to Ulba Metallurgical Plant and to Sogem U.S.A., a division of Umicore, for an approximate market value of US$9 million.

Under the Basic Ordering Agreement, there were no awards in July 2003, stated the DNSC on August 5th.

On September 5th, DLA/DNSC announced that it had sold 38 000 lb of vacuum grade metal and 2 200 lb capacitor grade metal to Cabot and H.C. Starck Inc. for $2.2 million, under the Basic Ordering Agreement procedure.

UN REPORT

The report by the UN Panel of Experts due at the end of July 2003 (Bulletin 113) will now be published around the end of October, as the Panel has been given an extension to its mandate.

EUROMETAUX

Eurometaux, the European Association of Metals which monitors particularly the directives of the European Union, will hold its annual Seminar on Environment, Health and Safety in Brussels on September 22nd and 23rd. Its focus will be on Environmental and Health Quality Standards legislation in Europe. The objective is to impart information on the status, policy and objectives of the setting of such standards, their potential business impact, as well as to introduce and discuss the long-term strategy and vision of Eurometaux on such standards.

STUDENT AWARD

The first Niobium Student Research Award was made in April to Daisy Bayot, carrying out research at the Université Catholique de Louvain in Belgium towards a doctoral thesis. The Award is given by Niobium Products Company, the German affiliate of Companhia Brasileira de Metalurgia e Mineração, and it was presented at a meeting arranged by the Institute of Materials, Minerals and Mining (IOM3) in London. The research concerned was an investigation of the coordination chemistry of niobium applied to the preparation of heterogeneous catalysts, a very promising field for the petrochemical industry.

STUDENTS ANODISE NIOBIUM

Chemistry teacher Myra Halpin of N.C. School of Science and Mathematics in Durham, North Carolina, has started a two year project in the anodisation of niobium and titanium. A piece of metal in solution with a 'slow electrical voltage' applied will gradually acquire a coloured coating as oxygen combines with the metal, her students will discover, and they can use the anodised metal to make rings or earrings. Ms Halpin says that students are more attentive and they enjoy coming to class when they have a practical project to interest them. The work has been made possible by a grant sponsored by Toyota Motor Sales, USA Inc. Mr Bill Seeley of Reactive Metals Studio, who specialises in niobium anodised jewellery, told us about the project.

ON THE MOON

Researchers at the University of Münster in Germany have used the relative amounts of tantalum and niobium in moon rocks to determine that between 35 and 65% of the moon came from an asteroid which hit the Earth and broke away a chunk which turned into our moon, the rest came from the asteroid itself. Comparison with the ratio of the elements in the Earth allowed them to estimate that this striking event took place 4.533 billion years ago.

MEMBER COMPANY NEWS

Angus and Ross

On August 5th Angus and Ross announced that it had entered into an agreement with Cabot Corporation for the purchase of its 50.1% interest in the Separation Lake lithium/caesium/tantalum property in Ontario, Canada. Following completion, Cabot Corporation will own 13.3% of the total issued capital of Angus and Ross plc.

In addition, Cabot has agreed to discuss offtake agreements for any tantalum produced from this project or any other projects developed by Angus and Ross.

Separation Lake is a joint venture between Tanco (owned by Cabot) and Gossan Resources, a Canadian mineral exploration company. The property is central to the English River greenstone belt, described as 'highly prospective', which hosts lithium, tantalum and caesium mineralization; the English River belt is an easterly extension of the Bird River belt which includes Tanco's Bernic Lake mine. The Separation Lake property is also only about 200m from the 'Big Whopper' pegmatite of Avalon Ventures, with its large reserves of tantalum oxide.

Angus and Ross is also looking to work on its property in Queensland which has tantalum-bearing albite pegmatites and tantalite and gold in a nearby alluvial system at Grant's Gully.

Cabot

For the quarter ended June 30th 2003, Cabot announced on July 23rd a loss of $5 million, compared with a profit of $19 million for the same quarter in 2002. Commenting on 'a difficult quarter', Chairman and CEO Mr Kennett Burnes said that 'as anticipated, our volumes decreased sequentially in our tantalum business due to the timing of shipments of contracted intermediate and finished products'. The operating profit for Cabot Supermetals was higher in 2003 than in 2002 for the same quarter, but it had fallen considerably from the March quarter 2003. Volumes were much higher in 2003 than in 2002 'due to a combination of contracted tantalum powder, wire and intermediate product sales and some improvement in Asia Pacific volumes'. But volumes had decreased from those of the March quarter. The re-negotiation of some customer contracts had resulted in lower prices but extended contract terms.

Although there were signs of improvement in the electronics market, Cabot's tantalum business was not yet benefiting because there were high inventory levels in the supply chain, explained Mr Burnes. Also earnings were expected to decline in the 2004 financial year when a customer contract expired. He described Cabot's operating environment as 'challenging'.

In July Cabot Supermetals announced that it would open a Thin Films Manufacturing Unit in Columbus, Ohio, to develop tantalum materials for thin films applications, as a division of Cabot Supermetals. Further details were released on August 18th: a new facility would be built for the manufacture of 'sputtering targets and high performance materials' for use in semiconductors, optics, magnetics and flat panel displays. The unit was scheduled to be operational early in 2004. More than 50 people would be employed. The location was selected for its proximity to Ohio State University and Battelle Memorial Institute, as both have extensive resources in materials science, and in the Business Technology Center which specialises in 'converting businesses' technological innovation into commercial success'.

Commerce Resources

Further work on the company's Fir Carbonatite would take place during the summer 2003 field exploration programme, with initial fieldwork focusing on the recently discovered Upper Fir Carbonatite. Soil-sampling and prospecting for extensions to the known bodies would be carried out, and if results were positive a drill programme would follow. A bulk gravity separation test was expected to provide data on recovery rates of tantalum and niobium.

At the Verity property, the final phase of initial metallurgical investigations had 'revealed no impediment to the development of a full-scale process for the recovery and upgrading of the contained tantalum and niobium'.

EPCOS

For the quarter ended June 30th 2003, EPCOS reported a decrease in sales of 6% from the previous quarter. Sales in automotive and industrial electronics remained stable, but sales in consumer electronics and telecommunications had declined. The company posted net income of €2 million, a result attributed to its cost-cutting efforts. Further relocations of manufacturing to countries with low labour costs, such as Eastern European countries and China, were planned. 'The tantalum capacitors business is still suffering from overcapacity and above-average price erosion', the report added. With 'rigorous cost management', the company forecast sales for the September quarter would reach about the same level, or be a little higher.

Sons of Gwalia

The preliminary final report for the year ended June 30th 2003 showed consolidated net operating profit for the year at A$34.5 million, down almost 40% on the year ended June 30th 2002. Tantalum business restructuring during the year to reduce its medium-term production profile included closure of the Greenbushes underground mine and reduced plant-operating times at Wodgina.

Nevertheless, tantalum production for the year was a record 2 193 792 lb, with sales of 2 140 693 lb, exceeding revised budget estimates, and tantalum inventory levels had been reduced. Production in the year to June 30th 2004 was estimated at 2.2 million lb. The report commented on evidence of improvement in the electronics industry, particularly in the Asia Pacific region.

Haddington Resources

In the quarter ended June 30th, Haddington had mined 95 148 tonnes of ore, treated 101 128 tonnes and produced 53 035 lb tantalite. Processing through the treatment plant had been hampered by a defect in a crusher, and failure of a mining contractor to perform – a replacement for this contractor was being sought in July. Drilling had indicated a potentially large pegmatite resource as an extension to the Bald Hill project, and other exploration around Bald Hill was being actively pursued.

Kemet

On July 2nd Dr Jeffrey Graves, President and CEO announced a strategic plan to enhance the company's global position. Reorganisation of operations around the world would lead to the relocation of facilities so that they had good access to key customers and to key technical resources and took advantage of low cost resources. Although corporate headquarters would remain in Greenville, South Carolina, some functions would be moved in order to support activities in Asia, Europe and North America. Some commodity manufacturing would be relocated to Mexico and China to benefit from lower costs.

The company's facilities in Victoria and Matamoros, Mexico, focused on tantalum and polymer capacitors, and would maintain excellence in quality, service and delivery, while driving costs down. Kemet's initial production facilities in Suzhou, near Shanghai, would be operational in the last quarter of 2003, and manufacturing in China would grow rapidly, supporting 'efforts to grow our customer base in Asia', continued Dr Graves.

On July 21st Kemet reported financial results for the quarter ended June 30th, showing net sales of $105.4 million and a net loss of $3.6 million. Asian sales increased by over 40% in units and over 15% in revenue relative to the March 2003 quarter. But the firm was affected by 'sluggishness in the electronics industry, particularly in the corporate information technology and telecommunication equipment sectors', Dr Graves added.

The organisation of the David E. Maguire Campus of the Kemet Innovation Center was announced, named after Kemet's recently retired Chief Executive Officer, well known in T.I.C. circles. Mr Maguire had provided 'the visionary leadership, the strategic direction and the operational focus that allowed Kemet to become the global leader in the tantalum capacitor industry'. The Center aims to become the world's premier innovation centre for passive electronic technologies, consolidating the company's existing market research and technology research and development. It would deliver innovative products and develop robust production processes that could be used in any part of the world the company required.

Metallurg

For the quarter ended June 30th 2003, Metallurg reported a net loss of $4.0 million on revenue of $90.7 million, compared with a net loss of $7.2 million on revenues of $86.5 million for the June quarter 2002.

Ningxia Nonferrous Metals Smelting

Metal Pages published financial results for Ningxia Orient Tantalum Industry Co, a subsidiary of Ningxia Nonferrous Metals Smelting, on July 30th. A fall in operating revenues of 6.28% to the equivalent of $27.16 million for the first half of 2003 compared to the first half of 2002 was reported, in spite of increased exports of tantalum powder and wire.

NAC Kazatomprom

In an article published in June, Metal Bulletin reported that the Ulba Metallurgical Plant, controlled by NAC Kazatomprom, was processing tantalum at full capacity. It aimed to extend its range and produce high-value-added goods. The company had developed its ability to produce high-quality capacitor powder, but had delayed the start of industrial production 'because of the depressed state of the tantalum market'.

Ulba no longer sold the niobium residue remaining after tantalum had been extracted from ores, whose origins were in Africa or Russia, but could process nickel-niobium and ferro-niobium alloys, said Metal Bulletin.

Silmet

In August Silmet announced that it was shutting down production of its rare earths division for three months, according to Metal Pages, but the production of tantalum and niobium was unaffected.

Tantalum Australia

Tantalum Australia continues to report on its sponsored research programme on solid oxygen-ion-conducting membranes process (SOM). It has 'executed the exclusive world License Agreement with Boston University for the global rights to the process'. Laboratory runs using feedstock from Tantalum Australia with 60% tantalum pentoxide and 6% niobium pentoxide have been successfully carried out. Significant advances in the research include a reduction in the temperature required for the reaction, continuous feed of material, very low concentrations of oxygen and nitrogen in the metal produced, and improved yield. A potentially saleable Fe-Mn-Al-Si alloy results as a by-product, and the SOM membrane in the reactor undergoes no degradation during the process. The company foresees capital and operating cost advantages over the existing industry process, and competitive advantage particularly for aerospace customers.

Tantalum Australia announced on September 1st that it was developing an investment relationship with a Chinese company with a view to business with the Chinese rare metal market, to complement its relationships with European and American companies, especially Kemet.

Vishay

Vishay reported sales of $538 million for the quarter ended June 30th 2003, 17.5% higher than for the June quarter 2002, and better than the March quarter 2003, $532 million. Dr Zandman commented that although conditions in the worldwide electronics market remained difficult, he was pleased with the company's results. The broad product line and opportunistic acquisitions of Vishay allowed it to 'weather these difficult times in the industry better than our competitors'.

Tantalum-Niobium International Study Center
40 rue Washington,
1050 Brussels, Belgium.

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