Last month we started up a new series called "Treasure trove" to provide you with some background knowledge and interesting revelations about some of the exotic metals associated with stainless steels. Already we have found someone willing to take over this column for us in the immediately forthcoming magazine editions. He is none other than John Schmidt, Director of New Product Development at Ulbrich Stainless Steels and Special Metals. We hope you enjoy his first article on niobium.

Niobium

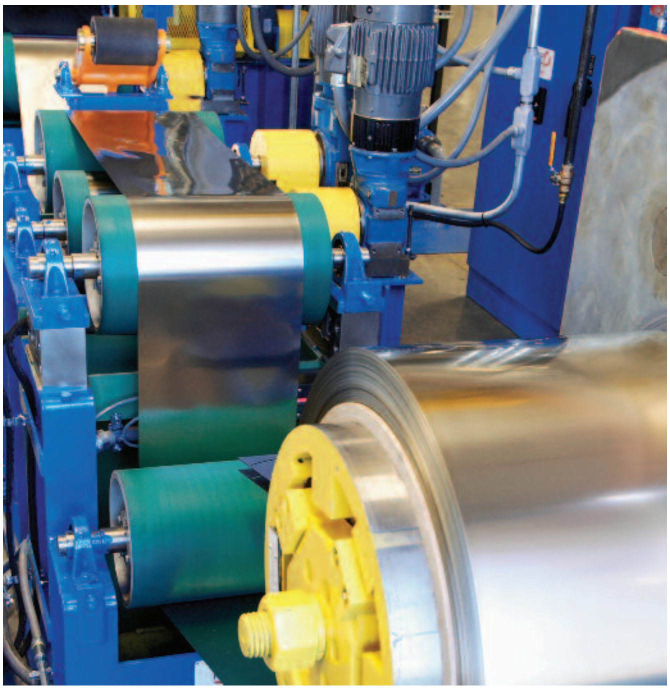
Niobium is named for Niobe, daughter of Tantalus, a Greek god. It has been confused with tantalum, named for Tantalus, and it also is called columbium due to confusion over its properties when it was originally discovered. Like its namesake, who was a controversial figure in ancient mythology, niobium has had its share of controversy too, virtually from its discovery until the mid-20th century.

There is a significant body of literature in the public domain which relates that niobium was first identified as a unique mineral in 1734 by John Winthrop the first governor of the colony of Connecticut. He named the mineral columbite and sent a sample to the British Museum in London, England, but it wasn't studied further until English chemist Charles Hatchett conducted tests on it in 1801. Hatchett determined that it was a new element, with properties similar to tantalum, and he named it columbium. However, after further studies, another English Chemist, William Hyde Wollaston averred that tantalum and columbium were identical, a determination that was refuted by a German chemist, Heinrich Rose, who reported in 1846 that tantalum ores contained a unique element that he then named niobium. But additional studies decades later showed that niobium and columbium were the same element – similar to but separate from tantalum – and it was called either, or both, until 1949 when it was officially named niobium.

Metallic niobium was finally isolated by the Swedish chemist Christian Wilhelm Blomstrand in 1864. Today, niobium is obtained from minerals including columbite and pyrochlore with vast reserves in Canada, Brazil, Africa, and Russia.

Commercial use of niobium began in the early 20th century and has traditionally been used in jewelry making and in various alloys, but in recent years it has gained widespread attention for its superconductivity properties. An alloy of niobium and titanium is used in the production of superconductive magnets, and other

A roller in action at Ulbrich



Fine metals sheets going through the annealing process.

Niobium	– Nb
Atomic number:	41
Atomic Weight:	92.906380
Electro negativity:	(Pauling) 1.6
Melting point:	2468°C
Boiling point:	4744°C

niobium alloys have found similar uses. Pure niobium is itself a superconductor when it is cooled below 9.25 K (– 442.75°F).
One of the most exotic uses of niobium is in the construction of superconductive cavities in the electron accelerator at the Thomas Jefferson National Accelerator Facility. The electron accelerator is used by scientists to study the quark structure of matter. The accelerator's 338 niobium cavities are bathed in liquid helium and accelerate electrons to nearly the speed of light. [1]
Niobium has physical and chemical properties close to those of tantalum, and the two are therefore difficult to distinguish.
For much of its early commercial life Niobium was used primarily in the manufacture of stainless steel and high-strength, low-alloy steels used in bridge construction, large diameter pipelines, and in automobile frames and wheels, where a high strength-to-weight ratio is desired and provides lower weight and fabrication costs.
Niobium is also used in the manufacture of jet engine components, rocket subassemblies and combustion equipment containing cobalt, iron and nickel-based alloys where strength at high temperature is crucial. [2]
While it has already shown its versatility through a wide range of manufacturing and research uses, niobium and its alloys also are becoming mainstays in the medical field. When treated with sodium hydroxide Niobium is a preferred metal for use in medical implants due to its ability to aid osseointegration – the process whereby bone tissue adheres to metal. Niobium also is physiologically inert and thus can be used in devices such as pacemakers.
Niobium is increasingly becoming the answer to manufacturers' compatibility issues with some implantable devices and platinum wires. Niobium also is used in various superconducting alloys containing titanium and tin that are applicable in the manufacture of MRI scanners. Other applications of niobium include its use in welding, nuclear industries, electronics, and optics.
Ulbrich Stainless Steels & Special Metals, Inc., produces

Cold rolling of sheets at Ulbrich.

Slitting sheets into fine strips.

precision strip and foil in two grades of niobium, primarily Type 1 typically for implanted medical devices. Type 1 consists of pure niobium, which is reactor grade, with a high melting point and is corrosion resistant. It also is used in high temperature industrial applications.
Type 2 niobium is a commercial grade alloy with an extremely high melting point and corrosion resistant properties. It has a higher residual Tantalum content, and like type 1 it has high thermal and electric conductivity, is easily fabricated, and is bio-compatible. Pure niobium is very soft, and can be cold worked to very high tolerances. All annealing must be done either in a vacuum, or an inert gas such as argon. For stamping and forming operations, a fine grain is preferred, which requires very precise control of annealing times and temperatures.

Notes
[1] http://education.jlab.org/sitetour/guidedtour05.html

John Schmidt is Director of New Product Development at Ulbrich Stainless Steels and Special Metals. He hold a BS in Metallurgical Engineering, Magna Cum Laude, from Drexel University and then served in the Peace Corps in the Philippines. He joined the Lukens Steel Company thereafter and served in ever increasing capacities in technical sales development, marketing and product development, including at the American Iron and Steel Institute and as a liaison to the National Research Council. Schmidt then joined Haynes International (then the High Performance Alloy Division of Cabot) and revamped its technical marketing for the Eastern U.S. and Canada. In 1993, he joined Ulbrich Stainless Steels and Special Metals. His professional organizations include ASM, and the International Titanium Association, among others.