ROCHESTER SECTION, INC. of the AMERICAN CHEMICAL SOCIETY

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Focus on Rochester Section Technology - Innovation Through Chemistry

Company: NiCoForm

Product / Technology: **Fabrication of precision metal parts by a proprietary electroforming process**

Web Site: **www.nicoform.com**

Address: **72 Cascade Drive, Rochester, NY 14614**

President & Company Founder: **Berl Stein**

Company Technical Areas: **electroplating, electroforming, inorganic chemistry, metallurgy, precision machining, process engineering, mechanical engineering, CAD, MEMS**

Number of Employees: **11**

Insight to identify technical and business opportunities, willingness to take prudent risks, the ability to develop the resources - technical, business, and financial - to meet a market opportunity and to react quickly to change are all characteristics of an entrepreneur. For Berl Stein, these characteristics have brought him from his native Soviet Union to Rochester, NY where he applied his technical and business skills to begin his own company, **NiCoForm**, in 1999.

Berl received B.S. and M.S. degrees in Chemical Engineering from the Moscow Institute of Fine Chemical Technology in 1974. In 1988, after years of experience in the Soviet printed circuit

board and plating industries, Berl emigrated to the US. He first found employment with an electroforming company in New Jersey, and in 1995 came to Rochester to work for Reflexite Corporation as an electroforming department manager. In 1999, NiCoForm was born out of Berl's interest in high-tech applications of electroforming.

The company's core technology is net-shape electroforming, an electroplating technique in which a thick metal layer is deposited onto a mandrel or original to be replicated. The resulting part, called an electroform, is then separated from the mandrel by a physical or chemical method. For electroforms with non-interlocking configurations, such as catheter tipping dies (Fig. 1A) and infrared shields (Fig. 1C), the final products can be physically separated from the mandrel, typically stainless steel or nickel, which can then be reused. A common sacrificial mandrel material is aluminum. It is electrically conductive, relatively inexpensive, can be easily machined to the desired shape and readily dissolved in sodium hydroxide to remove it from the final product when the mandrel geometry precludes its mechanical separation (e.g., for bellows (Fig. 1B), miniature enclosures, etc.). Nonconductive mandrels such as plastics, etched silicon, or silicone rubber are often used when the required patterns can be generated by photolithography or by etching silicon or glass for holograms or microfluidic devices. In these cases the mandrel must be coated with a thin conductive layer, usually by vacuum deposition or, in less demanding applications, by use of conductive silver or copper paints.

Electroforming is an atomic scale deposition process that can produce high replication fidelity of free-standing metal parts unmatched by any other technique. Compared to electroless plating, it has the advantages of significantly higher plating rates (up to ca. 2-3 mils/hour vs. ca. 0.5 mil/hour for electroless plating), as well as better process control and plating bath stability. Electroforming has played a critical role in producing coins and banknotes, LP records, CD disks and molded plastic holographic images. Prior to Berl's development of the proprietary Ni-Co alloy that is the core of his technology, copper and nickel were traditionally used in electroforming. However, neither possesses the tensile strength and elasticity that high-grade steels can offer, and both are insufficiently hard and wear resistant. Therefore, electroformed articles in applications requiring high strength properties had found only limited use. In addition, most electroforms with these metals required post machining because the deposited layers were neither smooth nor sufficiently uniform in thickness. This increased the cost of electroforms and hindered the competitiveness of electroforming as a manufacturing method.

Recognizing the need for improved metal properties for electroforms, Berl formed his company in 1999, with one part-time employee at its present downtown Rochester location. The company's initial application was providing selective plating services for mold repairs. The company's subsequent growth has been based on technical innovation and a sharp business focus on niche markets where the electroforming process can provide superior products. The technology driver for this growth has been centered on chemistry - the development of a proprietary Ni-Co electroforming solution and process that produce alloy parts of high tensile strength, elasticity, and wear and corrosion resistance - **NiColoy**®. Compared to conventional copper or nickel electroforming, NiColoy® technology significantly reduces the need for machining the electroform to achieve smoothness and thickness uniformity required by earlier electroforming processes. NiColoy® has mechanical properties that match the best modern engineering metals and can be electroformed stress-free to the near-net shape of the desired

object due to the novel features of this electrochemical process. Virtually eliminating post-machining, the use of this proprietary alloy has transformed electroforming into a cost-effective manufacturing method for a wide range of demanding engineering applications. Two modifications of NiColoy® are available - **high strength** and **high hardness**, depending on the target application. The harder deposit is more suitable for mold inserts and mold repair applications. The high strength deposit exhibits a unique combination of elasticity and plasticity and is used to electroform bellows and other dynamic components.

The company's sales growth has been achieved by a focus on niche markets where this electroforming technology with the new Ni-Co alloy can provide superior performance/cost to the customer. The company has identified high-value products in the medical, biotech, optical, and aerospace markets as ideal targets for its electroforming technology. Fig. 1 illustrates three of the main product areas of NiCoForm for these markets – catheter molds, (these can often be fabricated with reusable mandrels), infrared shields and bellows (these require that the mandrel be dissolved to release the electroform). NiColoy® bellows with walls as thin as 0.0004 inch (10 microns), and diameters as low as 0.03 inch (0.75 mm), much smaller than possible with alternate fabrication methods, have been produced by NiCoForm. At the other end of the size spectrum, bellows up to 10 inches in diameter and 25 inches long have also been electroformed.

In addition to NiColoy®, precision parts can also be electroformed in nickel, copper and gold. Electroforming can also readily provide multi-layer structures. For example, infrared radiation shields, which are used to protect detectors found in IR cameras, guidance systems and other IR devices from stray radiation (Fig. 1C), are electroformed as multi-layer structures of copper, NiColoy® or nickel, and gold, sometimes containing internal baffles. These shields usually have tight dimensional and weight tolerances and their internal and external surfaces are often coated, respectively, with low and high emissivity coatings, although other configurations and finishes can be fabricated by appropriate electroforming processes. NiCoForm has developed proprietary deep black and bright gold coatings on par with the best in the industry. Their precision CNC (Computer Numerical Control) machining capabilities and advanced electroforming technology provide metal parts which combine tight dimensional and weight tolerances with high process yields, resulting in quick turnaround times on competitively priced components.

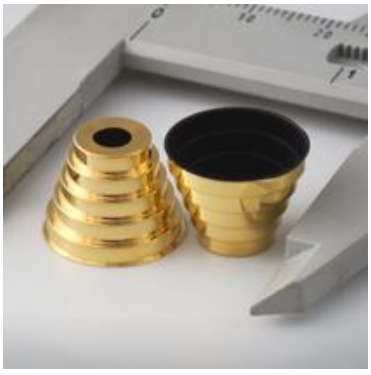
From its beginning in 1999 with two employees to its current eleven employees, NiCoForm has steadily grown in both size and product portfolio – a growth driven by technical innovation and a laser-like focus on providing customers with superior products and service. 2008 was a banner year for NiCoForm – its first $1 million revenue year and, despite the current poor economic environment, its unique technology and established markets and customer base promise to provide continued growth in the coming years.

The company WEB site (**www.nicoform.com**) has a wealth of information on its technical capabilities, products and electroforming technology. NiCoForm will also be the highlighted company at the Section's April 7 Networking Mixer at MacGregors (300 Jefferson Road, Henrietta – 5-8 p.m. - see the Section website, **www.RochesterACS.org**, for details)

Fig. 1: Some Examples of Metal Parts Fabricated by NiCoForm's Proprietary Electroforming Technology. A: Catheter Tipping Dies ; B: Bellows ; C: Infrared Radiation Shields

A

B



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