The Cutting Edge

Japanese Samurai swords are renowned for their beauty and functionality. They demonstrate the great knowledge of metallurgy which swordsmiths of that era possessed. An individual sword was in fact built by many craftsmen specializing in one part or aspect of the sword. There were the artisans who forged the blades, and others who tempered them and still another who polished and sharpened it. The blades themselves were laminates of multiple steel alloys all lending various qualities of strength, resilience, and, of course, sharpness to the blade. The swordsmiths of Japan were experts at forge welding and lamination of steel, so it was very natural for them to attempt to use non-ferrous metals in a similar fashion. A swordsmith by the name of Denbei Shoami made the first known laminates of copper, silver, and gold alloys known today as mokume gane (wood grain metal).

Mokume Gane Tsuba by Denbei Shoami in copper and shakudo - 18th century.

They resembled layered lacquer work, which was highly esteemed at that time. Over the years mokume gane techniques evolved and many beautiful pieces of sword furniture were created.

Other decorative articles were also made for export in the late 19th century, though because there was no history of this kind of personal adornment, they did not include jewelry. Gradually western metalworkers became aware of this beautiful laminated metal known as mokume gane and did their best to duplicate the technique. Many tried, including Tiffany, though western mokume was soldered laminated and remained inferior. For many years mokume remained a metalworking oddity that fascinated a group of dedicated (and somewhat masochistic) artisans with the potential of the amazing patterns that could be created with the technique. The problem was, that defects in a laminate of solder bonded mokume were inherent. Gas bubbles and trapped particles of flux created flaws that caused de-lamination and rendered it useless for shaping into complex forms.

Mokume Gane vase in copper, kuromido, and shibuichi by Gyokumei Shindo – mid 20th century.

In 1970 two American metalsmiths named Hiroko and Eugene Pijanowski went to Japan and saw traditional mokume that had been formed in to beautiful vases. The Pijanowski's had worked with mokume and knew how difficult it was to form. Yet what they saw showed none of the defects of their own mokume. They tracked down the maker of the vases, who agreed to show them his traditional methods, which until that time had been highly guarded secrets. The technique, which he employed, was a liquid phase diffusion bonding technique in a controlled (reducing) atmosphere. The Pijanowski's brought back this knowledge and began teaching it to others. Extensive research was done in the 1970s at Southern Illinois University at Carbondale and the University of Michigan exploring new lamination techniques that took advantage of more modern tools and materials. In the 80s and 90's a few artisans such as Steven Kretchmer,

James Binnion, and myself began working with colored gold, platinum, and palladium alloys utilizing solid state diffusion bonding techniques, digitally controlled furnaces and inert atmospheres borrowed from industrial methods.

Mokume Gane teapot in silver, copper and brass by James Binnion - 1996.

In the late 1990s I began looking for other metals that would provide a wider color palette of metals for use in mokume gane. Traditional copper, gold and silver alloys with patinas offered great color, but since most of my work was jewelry, these colors would not stand up to everyday wear. In particular I was looking for a dark colored metal that I could combine with platinum that would create a high contrast with it. I stumbled upon tantalum, a beautiful rich dark gray metal with fantastic ductility. The problem, of course, was that tantalum is extremely reactive at elevated temperatures and all of the bonding techniques I was using at that time were inadequate to overcome its affinity to oxygen. I began to explore different ways to use tantalum in my work and found that I could use tantalum that had been clad with copper and get satisfactory results. I had an

extrusion company co-extrude a thin layer of copper over a tantalum core and was able to get good bonding between jewelry metals to the tantalum via the copper interface. I did the same with CP titanium. Use of titanium allowed me to exploit its exquisite interference colors, which opened up a whole new avenue of artistic exploration.

950 platinum and titanium wedding band by Steve Midgett – 2004.

In tandem with exploring new metals for mokume gane, I also was working on developing techniques to mass-produce patterned metal laminated material. Up until then patterned metals such as mokume gane or Damascus steel could only be produced by highly skilled artisans in small quantities. I knew there had to be a way to make complex patterned metal in large quantities and extrusion offered a way not only to bond disparate metals, but also to make large quantities of material. I slowly integrated my knowledge of patterned metals and extrusion and developed techniques for patterning and extruding large billets of Extrusion Patterned Metals, what I call XPMs.

A variety of XPMs utilizing titanium, tantalum, platinum, 18K gold, and stainless steel – 2008.

In 2006 James Binnion and I became partners and started Extrusion Patterned Metals Corporation to further expand this work and provide beautiful, cutting edge patterned metals to other manufacturers for use in their own products.

Steve Midgett
President
Extrusion Patterned Metals Corporation

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Developing Extrusion Patterned Metals