PMC Decade

The First Ten Years of Precious Metal Clay

Book design by Tim McCreight

Cover image:
Coba, Brooch, Claire Holliday
fine silver, fine gold. 1⅜"

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INTRODUCTION

Tim McCreight

In August of 1994, Ron Pearson met with two men from Japan to discuss a new art material. He invited me to sit in, and the next day, two business executives laid out on his kitchen table several trays of silver jewelry that they said was made from something called Precious Metal Plasticene. They showed us a clear plastic box that held a beige-colored lump wrapped in plastic, and said that the jewelry on the table was made from this stuff. Yeah, right.

Well, of course, now we know what they were talking about. It took about two years to bring Precious Metal Clay (yes, there was a name change) to the US market, and since then the metal clay community has seen a lot of changes. For one, a decade ago there was no such thing as a "metal clay community." In fact, most of us remember when saying "PMC" brought only puzzled looks, and the term metal clay was nothing more than an oxymoron. Now metal clay has established a beachhead in the jewelry world, with about two million dollars worth sold in the US last year. Jewelers, potters, and artists from many other disciplines have found in PMC a welcome companion to their other work, and a legitimate form of metalwork that provides easy access. A search on Google for "Precious Metal Clay, PMC" turns up 120,000 entries—not bad for something that didn't exist fifteen years ago. Across the country and around the world, professional jewelers, craftsmen, hobbyists, and students are finding new ways to make PMC their own. This book celebrates the first decade of PMC outside of Japan.

Because it is such a new material, PMC offers a unique opportunity to observe the growth of the field, a bit like the pencil lines in the doorway that mark our children's growth. At the back of this book, you'll find a timeline that marks the key moments of the history of PMC. For the record, let's go back to the beginning.

On July 12, 1994, Mitsubishi Materials Corporation of Japan was awarded a patent number 5,328,775 for a product called "a moldable mixture for use in the manufacturing of precious metal articles." The material had been introduced a year earlier in Toronto at a meeting of the International Precious Metals Institute. Here is an excerpt from the paper presented there:

> Precious Metal Plasticene (PMP) seems to be just a simple mixture of metal powder and binder, but it promises to be an innovative and epoch-making material with capabilities not possible with traditional cast alloys. By using PMC, various shapes of precious metals can be made easily by hand forming, just as with porcelain or potter's clay.

Perhaps the most frequently asked question from newcomers learning about PMC is, "What did they have in mind?" In the early 1990s, Mitsubishi Materials built a state-of-the-art factory in Sanda, Japan to increase their production of highly refined

gold for use in microchips. Once the production lines were up and running, Dr. Morikawa, the director of the plant, let his mind stretch to the other possibilities of this remarkable facility. "What if we could alter silver and gold—two materials that everyone knows require great skill to work—to create a material that is as easy to form as children's modeling clay?" That was the motivation to create PMC—just to see if it could be done.

After a few false starts, the marketing division of Mitsubishi Materials discovered that their real market lay with individuals who wanted to make silver and gold jewelry but did not have the time to pursue a traditional course of study. PMC offered a radical new way to work with precious metals; a freedom and immediate gratification that was unknown in the 5000-year history of metalsmithing.

After a few months of sales in Japan, the marketing team at Mitsubishi turned its eyes to the US, which brings us back to the meeting at Ron Pearson's house. The immediate result was to sponsor a research retreat at the Haystack Mountain School in Maine. In May of 1995, fifteen metalsmiths gathered to experiment with PMC. This was followed by a contract with a US distributor, several articles in national magazines, and some early workshops.

The chronology that starts on page 231 gives some idea of what happened next… and next… and next. It is a rare opportunity to have the full provenance of a significant artistic development. We are young enough as a community to look over our shoulder and still see the trails that brought us to where we are today. But while the history is interesting, far more important than that is the artwork featured here. In these pages you will see what happens when creative artists encounter a material that is free of preconceptions and established practices.

For this book, I have collected what I consider to be some of the most exciting work currently being made with metal clay. The selection is personal, biased, and fleeting—a snapshot of a crowded street. I am confident of two related but opposing facts: First, that in a not too distant future, designers will look back on this work as seminal, and, paradoxically, that the work created in the second decade of Precious Metal Clay will dramatically surpass the work we admire today. That, thank God, is the nature of art.

Let me close with a story: The first samples of PMC to be shipped to the United States were in three large boxes sent to supply the 1995 research project. Customs officials called, seeking clarification about the mysterious contents of those boxes. The stuff looked like clay, but the uncommon weight and the high value didn't make sense. The label said "silver," but any fool could see there was no silver in those beige-colored lumps wrapped in plastic. The paperwork said "metal clay," which they figured must be a typo. Who ever heard of such a contradictory thing as metal clay?

PROGRESS AND POTENTIAL

Donald Friedlich

Precious Metal Clay was first introduced to the American market about a decade ago. Now that the medium of metal clay has had time to mature, this is an appropriate moment to look back at its evolution, to review the current state of its use, and to judge metal clay alongside the history of contemporary jewelry and metalsmithing as well as the concurrent history of ceramics.

In reviewing metal clay, we must first recognize that in all art it is not the material itself, but the depth of the exploration and finally the quality of what is done with the material that counts most. At the same time, the choice of material is a critical element in any work of art. If that choice proves inappropriate, superficial, or otherwise poorly considered, the artistic vision can be compromised. Each time a new art material such as metal clay is introduced, the quality and nature of the work done in the material goes through familiar evolutionary stages. When looking at the evolution of metal clay, it is instructive to first look at the history and the development of another material, reactive metals, for both its similarities to, and differences from, metal clay.

Almost immediately after the reactive metals niobium and titanium were introduced to the United States in the late 1970s, the color palette of blue, purple, pink and green seemed to be everywhere. Many jewelers were seduced by the ease of bringing color into their work and soon these metals became the flavor of the month. Regrettably, the great majority of this work was gaudy, flat, and overly reliant on the process for its impact. Artists like British jeweler Edward de Large, who used the materials to communicate a distinctive artistic vision, were few and far between. The use of reactive metals was pervasive for the next five years or so, and then, for the most part, it burned itself out. While some artists continue to work with reactive metals today, its use has declined dramatically from its heyday.

While the proliferation of artists working with metal clay may be reminiscent of the growth of reactive metals, efforts to guide development along a much broader path have engaged a larger audience. This bodes well for the longevity of metal clay and it does not appear likely that metal clay will flame out the way reactive metals did. In fact, it is already clear that metal clay is not a mere trend or flash in the pan. Rather, metal clay has its own sustainable subculture that is likely to continue to grow for many years to come.

The marketers of metal clay recognized, quite rightly, that the material is very well-suited to self-taught makers and people who are new to metalsmithing. There is a relatively short learning curve associated with metal clay, especially when compared to the extraordinary amount of time required to gain traditional goldsmithing skills. The skills required to work with metal clay can usually be acquired in a matter of days, with advanced training taking less than a week. Further, the use of metal clay does not require much equipment; all that is needed is a kiln and some rudimentary tools. As a result, people can easily work with metal clay in their homes. The minimal equipment demands also mean that the use of metal clay can be taught outside traditional studios. Classes are frequently held in hotel meeting rooms and the like.

In addition to training makers, the manufacturer and distributors of PMC have placed a significant emphasis on training teachers. As the old saying goes, give a man a fish and he will eat for a day, but teach a man to fish and he will eat for a lifetime. Through a series of Master Classes and the development of a certification program, they took the next step—they taught people to teach fishing. This approach made a huge contribution to spreading metal clay to new audiences.

The big-tent marketing and development of metal clay has yielded a very positive outcome, in large part because the material allows a new point of entry into the world of precious jewelry besides the traditional routes of the university, the art school or the trade. Metal clay also engages a completely new audience and very quickly gets them excited and making objects. In this regard, metal clay has no equal.

Of course, as with reactive metals and other materials and processes, the ability to work with metal clay, or even to teach classes in its use, does not necessarily mean that one can use it in an artistically inspired manner, and despite the impressive growth of metal clay, acceptance by the mainstream art jewelry world has been slow. Some still regard the material with a degree of skepticism. Jewelers and metalsmiths who have spent many years acquiring their much-prized metal skills look down on the ease of working with metal clay and don't consider it "real metal."

In an academic setting, some faculty feel they simply do not have the time to add another process to an already crowded curriculum. Others fear that introducing a material and process to students that is so immediately grasped will play into what

is seen as a pervasive MTV-paced, short attention span among students and will preclude those students from developing the needed patience and skills demanded by traditional jewelry processes. While this resistance is somewhat understandable, it seems largely misplaced as well as altogether too familiar. When lost wax casting, electroforming, hydraulic press forming, and other new techniques were first introduced, similar concerns were expressed. Change is a constant in our world and so is resistance to change. Looking back at these earlier experiences, skeptics have been proven wrong so consistently throughout our history, that by now we should realize that new materials and techniques are not, in and of themselves, bad or corrupting, but are more rightly viewed as potential opportunities in need of realization and the artist's touch. It takes time for a field to set aside its own history and preconceptions, and even longer to find a new material's inherent uniqueness and expressive range and to integrate that information into artistic and technical vocabularies. A new material or process (and metal clay is both) should be entitled to a non-judgmental honeymoon period and be given time to develop in the early years of its life. Only later, as it reaches its maturity, should it be evaluated in the context of the full history of the contemporary art practices of its larger field.

In this context, examining an object made of metal clay raises many critical questions. What does the object communicate? Does the object speak with an expressive voice that is unique to this very different material? Has the object been done before to the point of being trite, or is it new and distinctive? Could it be better made in another way, with other materials? Does it exploit the material's ability to showcase the imprint of the hand in ways metalsmithing cannot? When it is inappropriate to have the hand in evidence, does it demonstrate proper technical control and refinement of surface and form? Does it take advantage of metal clay's ceramic qualities and genuinely exploit the fact that metal clay is, first, formable with the ease of clay and then is almost magically transformed, like a caterpillar to a butterfly, into a silver or gold object? With these questions in mind, we shall look at the objects in this book. One of the unique qualities of metal clay is its ability to take on almost any form with relative ease. That said, metal clay's formability can lead to the production of gloppy and unresolved shapes. The work sometimes shows evidence of the hand when this

CeCe Wire,
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Tina Rath
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is not in the best interest of the design. A lack of control of the medium is also often evident. Using metal clay in a crisp and clean manner is more of a challenge. Some of the artists in this book are able to control metal clay to such an extent that their forms appear fabricated of sheet, when in fact, the work would be extremely difficult, if not impossible, to fabricate. These artists control metal clay, instead of letting metal clay control them.

CeCe Wire provides an excellent example of control over the metal clay in her skillfully rendered hollow double rings with three dimensional agricultural and architectural images from the American farm such as barns and grain silos. Wire's flat surfaces are dead flat, her right angles exact, and her seams clean. Wire's silo forms are especially well executed, with a delicate ribbing that accentuates the cylindrical shape and at the same time clearly makes reference to the construction of the actual silos that are her inspiration. The location of each small square window is chosen with care and sensitivity. Were these pieces to be cast, at least four separate castings would be required. Were they to be fabricated from sheet metal, the simplest of them would need at least half a dozen challenging fitting operations and laborious scoring and bending. Metal clay is well-suited to this sort of hollow fabrication and its use allows the entire top of the ring to be made and fired at one time. The sterling ring bands are soldered on subsequently.

Tina Rath also shows mastery over the metal clay in the tentacles of her sensual silver, wood, and mink brooch. Each of the hollow tentacles is topped with a small diamond. Rath maintains the distinctive style of her well established work, but is able to use metal clay to extend and complement that style. It is a challenge for an artist to bring a new material into her vocabulary, to be sensitive enough to exploit that material for its unique qualities, and at the same time to maintain her own mature artistic voice, but Rath succeeds admirably.

PMC is easily embossed in a variety of manners and this ease tempts some artists to "go over the top" with texture and pattern. Such pieces lack a point of contrast. The

Yasutaka Kita
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Tim McCreight
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Celie Fago
page 220

patterns are relentless, with little structure and no place for the eye to rest. Knowing when to stop is critical to the success of a design. Sometimes, less is still more.

Pattern is very effectively employed by Japanese artist Yasutaka Kita, who draws his inspiration from nature. His delicate honeycomb and bee brooch employs the repetition of 187 identical hexagonal shapes. The repetition of the same form visually grounds the brooch. Variety is found in the careful choice of where the pattern ends. The viewer is made very aware of the length of each line of hexagons as well as the asymmetrical outside contour of the design. As with ikebana, the Japanese art of flower arranging, each element is perfectly placed. A patina darkens the silver to heighten the appearance of the final element, a golden bee, which becomes the center of attention.

Although intentionally less structured, Tim McCreight reveals a similar Zen sensibility in his brooches. McCreight also uses the repetition of line elements, but each of his lines has a subtle calligraphic variation of width, as if they were painted by hand with a brush. In one brooch, a single red bead is held in place by gold-colored thread. The design brings to mind the directness of construction of traditional Japanese wrapping and packaging.

Celie Fago's bracelet is richly patterned with a surface that resembles cuneiform tablets and hieroglyphics. The patterns continue on the articulated hinges and clasp of the bracelet. The hinges are used for practical reasons of comfort in wearing, but they are also a vital design detail serving to frame each of the four embossed panels. The straight edges of the hinges are elegantly contrasted to the irregular outside edges of the panels that resemble the deckled edge of handmade paper. Fago has also accentuated the silver surface with the addition of gold keum-boo.

Kathleen Browne makes theatrical and lyrical rings that bring to mind the tiers of a wedding cake. The rings are decorated with icing-like rosette forms that are designed to jiggle as the hand of the wearer moves. Jewelry is one of the few art media that is generally seen in motion and Browne is able to exploit and draw attention to that unique quality. She also makes good use of gold metal clay, applying it sparingly to accentuate her forms.

Kathleen Browne
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Hannah Louise Lamb
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Claire Holliday
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Hannah Louise Lamb also exploits repetition of movable elements. Her small pinched shapes are the result of a primary response to clay, pinching it between the thumb and forefinger of each hand. Lamb burnishes the edges of each pinched form to contrast the matte white of the fine silver and further define the form. The pinched elements are movable, inviting placement by the viewer on the concave side of a richly textured and subtly curved cylindrical section.

In a beautiful child-like chain necklace, Lamb also uses the repetition of similar elements that show the use of the hand to bring subtle variation in shaping them from metal clay. The design is simple, restrained, very wearable and elegant. It cries out to be played with and touched. It is one of the most appealing necklaces in the collection.

Like traditional clay, one of the most distinct qualities of metal clay is its ability to show a seemingly endless variety of textures. In a diverse and exceptional body of jewelry, Claire Holliday has been able to marry unique forms with sensitive choices of texture. As much as any work in this collection, Holliday's jewelry takes advantage of metal clay's unique ceramic qualities. Her bark-like pendant (page 213) has a distinctive clay-like rawness that brings to mind some of Adriane Saxe's ceramic work as well as that of Peter Voulkos. The composition is simple, but extremely potent. The negative space of the knot hole is at the same time mysterious and sensual. Every mark feels right, as if no other mark would be satisfactory. The same can be said about her highly organic "Maize Pendant."

Holliday's two "Sea Seed" brooches have the tension of taut fabric stretched over a supporting armature (pages 112 & 113). The implied roots of the thorny points at the edges of the brooches run into the body of the design, as if they had grown together. In her "Five Rings" brooch (page 87), Holliday also provides a structure in the repeated round ring shapes, and then uses them as a physical anchor for, and visual point of contrast to, the softer organic nipple forms. A dot of Aura 22 at the tips of the forms adds a final dash of richness to the brooch.

Sanaé Asayama
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Myra Mimlitsch-Gray
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Like Holliday, Sanaè Asayama truly exploits metal clay to its best advantage. The texture and gesture of her 24k gold, amethyst and tourmaline brooch is sensitive and delicate while at the same time bold and dynamic. One can feel the movement of the clay as if it were a wave crashing in the ocean. It also brings to mind the much prized contemplative Japanese lingbi rocks. Asayama's other equally successful brooch of 24k gold and pearls is made of extruded spaghetti-like metal clay. The energetic extrusions flow in a seemingly random manner, causing the eye to follow them on their travels around the brooch, as one would the streaking drips of a Jackson Pollock painting. The use of a symmetrical circular form brings a point of grounding and contrast to the snaking gold line while the hollowness of the form adds to the compelling perception of delicacy. Gold is expensive and 24k metal clay even more so. It is refreshing to find an artist who seems able to ignore that and work with the material with artistic abandon.

By many accounts, Myra Mimlitsch-Gray, whose work often recontextualizes classical hollowware forms, is the most artistically sophisticated and accomplished silversmith working in the United States today. Her work in metal clay dates to that original 1995 research workshop at Haystack Mountain School of Crafts. More than any artist in this book, Mimlitsch-Gray has taken a Peter Voulkos-like, irreverent and almost violent approach to metal clay, by simply stepping on the clay with her sneaker to make a wonderfully raw and crumbly object that is rich with texture. This object could be made of no other material. I wish more artists would take advantage of this sort of approach to metal clay.

J. Fred Woell is well-established as a pivotal and influential figure in contemporary American jewelry. Woell's skills and experience allow him to make informed decisions about which process is best to achieve a given artistic goal. In his "Market Place Pin" Woell incorporates richly textured metal clay and his signature cast sterling elements taken from American culture. As is often the case with Woell's work, this brooch is both humorous and wryly critical of American consumer culture.

Unlike lost wax casting, in which hollow construction is very challenging, com-

plex hollow forms can be made relatively easily in metal clay simply by shaping the clay around a core that burns out during firing. Working hollow has many benefits in jewelry: it minimizes costs, keeps the weight of the piece down and allows for the production of larger objects than would be practical as jewelry were they solid. One of the most frequent applications of hollow construction in metal clay has been in the making of beads.

Barbara Becker Simon combines many of the textural devices discussed earlier, but in three dimensional hollow beads. In her "Red Rock Necklace," Simon combines unusual geometric natural stones with metal clay beads that are shaped and informed by the stones, to produce jewelry that is architectural and dramatic. Simon's solitary "Ant Beads" (page 109) are alive with the frenetic activity of an ant colony. Instead of rendering the insects as an intaglio as most metal clay artists would, Simon takes the more challenging path of sculpting them in bas relief, making the piece much more compelling. While some might be put off by the insect imagery, the richness of the silver seems intent on dispelling any potential unease, leaving only naturalistically inspired beauty.

Margarite Parker Guggolz also creates bead-like hollow forms, but she uses them in a very non-traditional manner in her rather scatological "Papyrus Bloom" brooch from her "Pod Series." The hollow but visually heavy and gnarled central metal clay pod is encased in a contrasting frame of thin corrugated sterling sheet. Although they don't make use of the contrasting elements or hollow construction, Guggolz's "Hive" (page 139) and "Relic of the Hive" (page 43) also from her "Pod Series" show a similar organic rawness. Interpreting nature, Guggolz has managed to find her own personal voice.

Alternative materials are frequently combined with metal clay, as they are in much of today's art jewelry. Because metal clay and polymer clay employ similar tools and skills, polymer artists have been drawn to metal clay as a convenient way to bring precious metals into their work. The two materials have often attracted a similar type of maker and have also been greeted with similar skepticism. In some ways they might be described as kissing cousins.

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Barbara Becker Simon
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Margarite Parker-Guggolz
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Kelly Russell
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Kathleen Dustin
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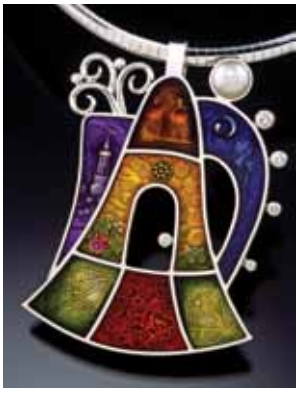
Kelly Russell very effectively marries polymer clay with metal clay in her bold floral brooches titled "Budding" and "Black Pearl Podling." (page 163) The brooches read as abstract corsages with a softly muted color palette and inventive attention to detail. They are mature works and Russell has found her own unique voice. While Russell also draws on flowers for inspiration in her rich red lacquered necklace, "Venus Guy Trap," the choice of a pointy and carnivorous plant makes the piece much more aggressive and threatening. Russell also makes clever use of found and appropriated objects to help shape the metal clay. In this necklace, she has molded the female figure from the handle of an antique spoon. The necklace has a baroque character of a medieval reliquary. The visual pun of combining a Venus fly trap with a Venus female figure is sophisticated and potent. It is very rare to see jewelry that is simultaneously baroque and contemporary.

Kathleen Dustin creates some of the most elaborate, painterly, and skilled work being done in polymer clay today. Her handbags take polymer to a level that only a handful can equal. Metal clay gives Dustin the ability to add silver accents to her jewelry that are customized to her polymer work. As a result there is a synergy between the two materials that elevates both.

There is a lot of strong and interesting work being done in high-fired enamel in the wider jewelry world today. The idea of enameling on electroformed copper was a major revelation which greatly expanded the options for enamellists. The work of two of the best American enamelists, Jamie Bennett and June Schwarcz, illustrates that electroforming, like metal clay, has an almost limitless form range. Like electroforming, metal clay can be used to produce hollow objects suitable for enameling and the two materials can also be fired in the same kiln. Because of these areas of confluence and the fact that metal clay is fine silver, one of the metals of choice for enamelists, combining metal clay with high-fire enamels seems like a logical area that demands investigation. While there are a few artists in this collection who combine enamel with metal clay to good effect, thus far, the combination appears to be vastly underutilized.



Ivy Solomon
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Noortje Meijerink
page 145

Ivy Solomon's work first appears to be enamel, but is in reality made using transparent colored resin in a manner that is reminiscent of an effect employed by Carl Fabergé in his famous Easter eggs. Fabergé made remarkable use of machine-turned textures and patterns covered by lusciously colored transparent enamel. While none of us can hope to equal Fabergé, Solomon gets a similar depth using resin over a textural montage of metal clay to give the work vibrant color and visual richness that is very similar to enamel.

When describing the physical and tactile process of working with metal clay, the most frequent material it is compared to is porcelain, so it's only natural that an artist who specializes in porcelain vessels, like Noortje Meijerink, would find metal clay intriguing. Meijerink is able to combine the two materials to take the best advantage of each. Her beautiful black porcelain vessels with white sgraffito birds provide a dramatic foil to the fine silver metal clay. It is especially pleasing that the metal clay is set down into the surface of the clay.

While one naturally views metal clay in the context of the history of metalsmithing and jewelry, the textural, form, and content range of contemporary ceramics should also be examined by any artist serious about metal clay. Ceramics is the most plastic of mediums and it provides a veritable goldmine of information and inspiration.

Without that historical context, metal clay, as a field, will be working with one hand tied behind its back. Based on the work done so far in metal clay, the ceramics world may well contain the secrets to metal clay's next evolutionary development. Bringing renowned ceramic artist William Daley in as the keynote speaker at the 2006 PMC Conference was an inspired idea, but just the beginning of unlocking the potential of this exploration.

Of all the ceramic artists likely to provide such inspiration the one who comes to mind first is Peter Voulkos, who brought to clay the same dynamic energy and con-

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STEFAN FRIEDEMANN

Peter Voulkos
"Alhambra" 1999
wood-fired stoneware stack
45" high by 24¾" by 22"
Courtesy of the Voulkos & Co. Catalogue Project

Gerd Rothmann
"Four-Finger-Bracelet"
18k gold, 1¼" by 2¾"
Courtesy of Ornamentum Gallery, Hudson, NY

cern for the artist's mark that abstract expressionist painters like Jackson Pollack and Franz Kline brought to the canvas. Voulkos's sculpture and vessel forms demonstrate an uninhibited, improvisational, and almost violent approach to his materials. One can also draw inspiration from the expressive range of Beatrice Wood, the subtle form explorations of Ruth Duckworth, Richard DeVore, and Ken Price, and the boldness of Adriane Saxe, to name but a few. These are artists of historical prominence but there are many others worth exploring who are younger and more current.

In the field of contemporary jewelry and metalsmithing, several artists come to mind whose aesthetic or technical approaches converge with metal clay's. Gerd Rothmann's remarkable gold jewelry taken from molds of human body parts, especially hands, is visually simple but extraordinarily potent and delicate. The metal clay world can learn from his example of restrained texture and effective use of one simple idea to create exceptional work. Similar lessons can be taken from John Iverson's leaf pins. Still more can be learned from Dennis Nahabetian's brilliant use of pattern as well as the variety of expression and depth of exploration he has found in the altered and electroformed metal screening he uses in his jewelry and vessels. Working with one mundane material, Nahabetian illustrates my earlier point that it is not the art material, but what is done with it that counts most. Karl Frisch often works with wax that is formed around found commercial jewelry components that he then invests and casts as one. The work recontextualizes the found object, bringing it new life. Frisch's work is conceptual in a way not yet seen in metal clay, and at the same time, it has some of the aesthetic of metal clay.

While metal clay can certainly stand on its own, combining it with other processes or materials has yielded some excellent results. A jeweler with a full range of technical and material options knows which choice will best achieve a given aesthetic or technical objective and makes the appropriate decision. Developing metal skills beyond metal clay alone, such as soldering, fabrication, and forming to name just a few, is invaluable, as is the study of the wider craft and art world.

Jamie Bennett
"Priori #11," Brooch, 1989
18k gold, 5½" by 1½"
Courtesy of the artist

June Schwarcz
"#2289," 2006
Enamel on electroformed copper foil
Courtesy of the artist

Sensitivity to a material and innovation are at the heart of making art, as is testing the limits of what can be done. The strongest work in this collection has all of these qualities. Some of the best artwork produced today in any field is the result of working in the cusp between two mediums, taking the best of each. It is here that we find new ground that hasn't been traveled before. By its very nature, metal clay is ideally suited to working in the cusp between metalsmithing and ceramics. Metal clay artists should endeavor to make objects that take the best from each medium. As more and more artists experiment with metal clay, I have no doubt that the work will continue to grow in sophistication, content, and skill. Perhaps in the next decade, someone will even make a body of work with metal clay that breaks radically new ground and shakes up the whole jewelry and ceramics world. If they do, I'd love to see it.

Donald Friedlich received his BFA from Rhode Island School of Design in 1982. He served a term as President of the Society of North American Goldsmiths and was also Chair of the Metalsmith magazine Editorial Advisory Committee. His jewelry is in the permanent collections of the Victoria and Albert Museum, London, Smithsonian American Art Museum, Museum of Fine Arts Boston, Corning Museum of Glass and others.

THE SCIENCE OF PMC

Darnall Burks, M.S. Physics

What is PMC?

In concept, Precious Metal Clay is an elegant and simple material. In fact, it is a highly technical product. The idea was the brainchild of a scientist named Dr. Morikawa, employee of Mitsubishi Materials Corporation in Japan. His goal was to develop a form of metal that had the feel and working properties of pottery clay. He reasoned that such a material would allow artists to create objects from silver or gold just like a potter makes ceramic items. In fact, the first PMC pieces were Japanese style tea ceremony cups formed on a potter's wheel.

PMC is made from pure silver or gold (or gold-silver alloys). Gold and silver are noble metals, a term which indicates that they react chemically much less than most common metals. One result is that they react much less against skin. People who have an allergic response to sterling silver may be able to tolerate fine silver, and that is why fine silver is used in medical implants and dental fillings. Another result is that noble metals are less likely to develop an oxide skin when heated. In PMC, this is what allows the particles to fuse together.

How is PMC Made?

The patented formula for PMC appears simple: pure water + binder + very pure silver (or gold) powder. In practice, however, several years of development went into getting the details right. The choice of binder was important. The scientists at Mitsubishi Materials chose a material often used as a food additive to assure that there would be no health risk. PMC has been tested and found to be 100% safe to handle and use.

Production facility of Mitsubishi Materials Corporation in Sanda, Japan.

To control shrinkage and achieve ideal workability, the amount of binder is kept to a minimum. This makes the mixing process critical to ensure that the components are distributed uniformly. The silver powder used in metal clay is very fine, finer than the finest cake flour. Further, the particle size and shape are closely controlled. The process used to make the silver powder is highly technical and a company secret. It is also an expensive process.

The silver, binder, and water are added together to make a homogeneous mixture, much as you would make cake batter. Process control is critical to ensure

that there are no lumps. There are many tests along the way to be certain that each batch meets high standards, and that each batch is the same.

There are different forms of PMC: clay, paste, slip. The basic recipe is the same, but proportions are adjusted and in some cases, additional materials are added to modify the handling characteristics. These changes have adapted PMC to formulations that allow it to be molded, rolled, squeezed out, or painted.

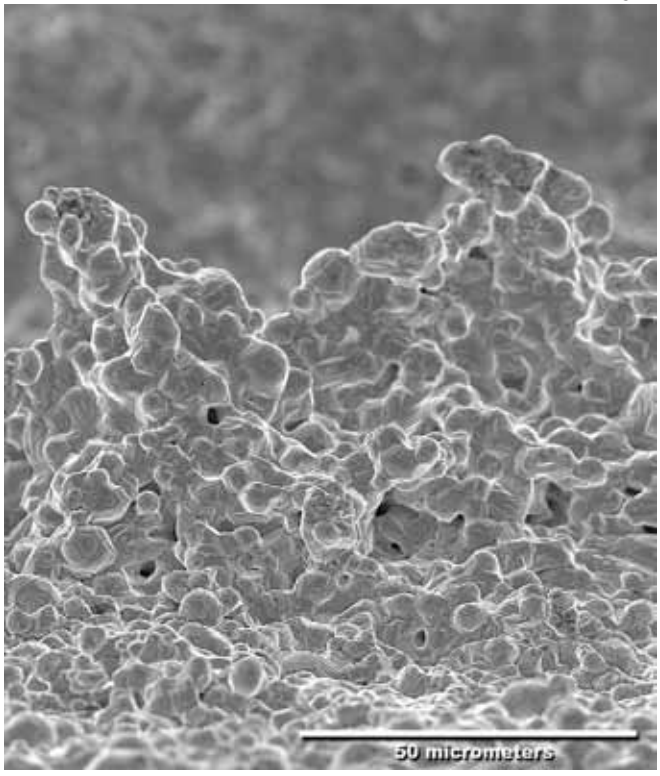
How Does PMC Work?

The series of steps involved in completing a metal clay object can be described as a person walking up a staircase. First, the PMC object is formed by any of a hundred different processes, including rolling, layering, imposing texture, etc. It is then set aside to dry, and we'll call this the first step. At this point, some of the water content of the PMC leaves through natural evaporation. This will happen passively, but artists sometimes accelerate the process by using warmers or dehydrators. At this point, the PMC is tough enough to withstand sanding, carving, and light polishing.

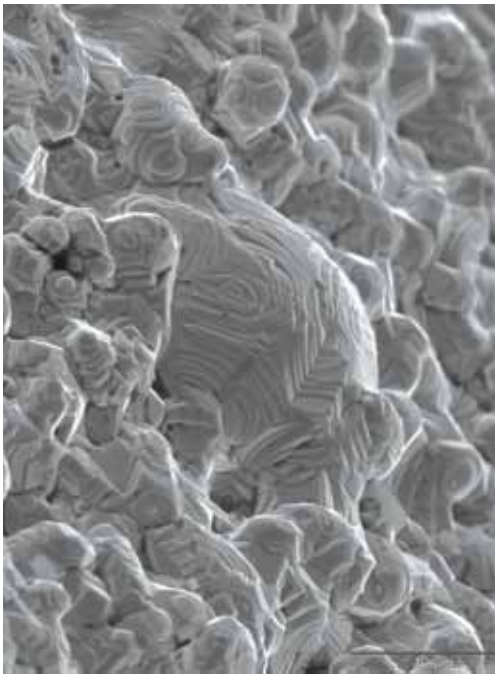
The work is then put in a furnace, where remaining moisture is driven off—step two. The third step occurs when the temperature rises to the flash point of the binder, around 500° F (260° C). This creates a bit of smoke, but no more (and nothing more dangerous) than burning a pan of biscuits. At this point, the PMC is fragile because the binder that was holding the form together has been removed. There is no reason to stop the process here, so in normal uses, the work moves along to the next step.

By now the temperature has risen high enough to "sinter" the silver particles together. Sintering is a scientific term that might not be familiar, but the concept is easily understood. Think of M&M candies. The hard coating keeps them from melting in your hand, just like their ads say. That is what the binder does in the early stages of PMC. When it burns away in the furnace, the result is analogous to a handful of chocolate chips. They don't melt and run. Instead, they fuse together into a big lump, and this is what happens to PMC. If you do it right, you can get a big lump, with no holes and no change in shape. This is the last step, or really a series of

Photo by Tina Carvalho, MicroAngela



This image was taken by a scanning electron microscope, and shows properly sintered PMC at a magnification of 1000 times actual size. The individual silver particles have fused together to form solid metal.



At even higher magnification, each silver particle shows the crystals of which it is made.

Photo by Tina Carvalho, MicroAngela

steps as increasing temperature and soaking time draw the silver or gold particles together into an increasingly denser mass. There is a final step, but we don't want to go this far. If you put the chocolate chips into a saucepan and continue to raise the heat, they will become fluid and flow into a liquid mass that has no resemblance to the original pieces. This is analogous to what happens if PMC is heated above the melting point of fine silver.

Metals are crystalline materials. When they sinter, the tiny crystals grow together, following an orderly arrangement. Perhaps you've seen pure sugar crystals that look like faceted gems. The crystals you can see are larger versions of similar crystals that are too small for the naked eye. In the case of pure silver and pure gold, microscopic crystals join together according to rules of geometry and physics to make a solid structure. The scanning electron microscope allows us to penetrate this remarkable world. The crystal facets on "mountains" were originally separate particles that have now fused together. These tiny crystal facets are what make silver PMC come out of the kiln with a white surface. Burnishing or abrading the facets smoothes away these light-catching facets, and turns the material mirror bright.

One last point is important to understand: sintering is a complex process. The very fine metal particles have a large surface area (and therefore a great deal of energy). The finer the particles, the lower the temperature required to sinter the piece. This is why PMC3 can be fired at a lower temperature than Original PMC. And this is why you can fire PMC well below the melting temperature of silver. But sintering is a time-plus-temperature process. A lower firing temperature always needs longer firing times. In practice, the safest approach is to use the highest temperature possible, depending on other materials in the piece. This will insure the best density and strength.

Are There PMC Alloys?

Most jewelry metals are alloys of silver, gold, or platinum with other metals. Sterling, for instance, is historically an alloy of 92.5% silver and 7.5% copper. Recently, alloys with other metals have been developed to make silver easier to cast, or to reduce fire-escale, or for other reasons. And, of course, alloys save money by diluting the expensive silver or gold with a cheaper metal. But all these other metals will oxidize in the furnace, and this prohibits proper sintering. All versions of silver metal clay are "fine" (that is pure) silver. This is often given the scientific designation .999, which indicates a purity of 999/1000.

When PMC was being developed in the early 1990s, the scientists working under Dr. Morikawa made their first tests with pure gold. It was the most noble of the noble

metals, and presented the most likely candidate for success. Once they had developed a formula, they moved on to silver. Pure gold PMC had excellent workability, but resulted in a metal that was too soft for practical use. In 2006, Mitsubishi scientists came full circle, using the information developed in their silver research to develop a new gold alloy. The new PMC Gold is a 22 karat alloy of 91.7% gold and 8.3% silver. This alloy has a lovely yellow color and a strength that is greater than conventional 18k gold.

Conclusion

Mitsubishi Materials Corporation won its patent for PMC on July 12, 1994, and introduced it as a commercial product within that same year. Since then, scientists working at the Sanda Plant in Japan have developed clay that can be extruded, painted, and fired with a torch. Density and workability have been improved across the board, so artists today have a wide range of options to match their diverse needs. It is impossible to predict what new versions might be invented in the future, but it seems certain that they are not done yet.

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