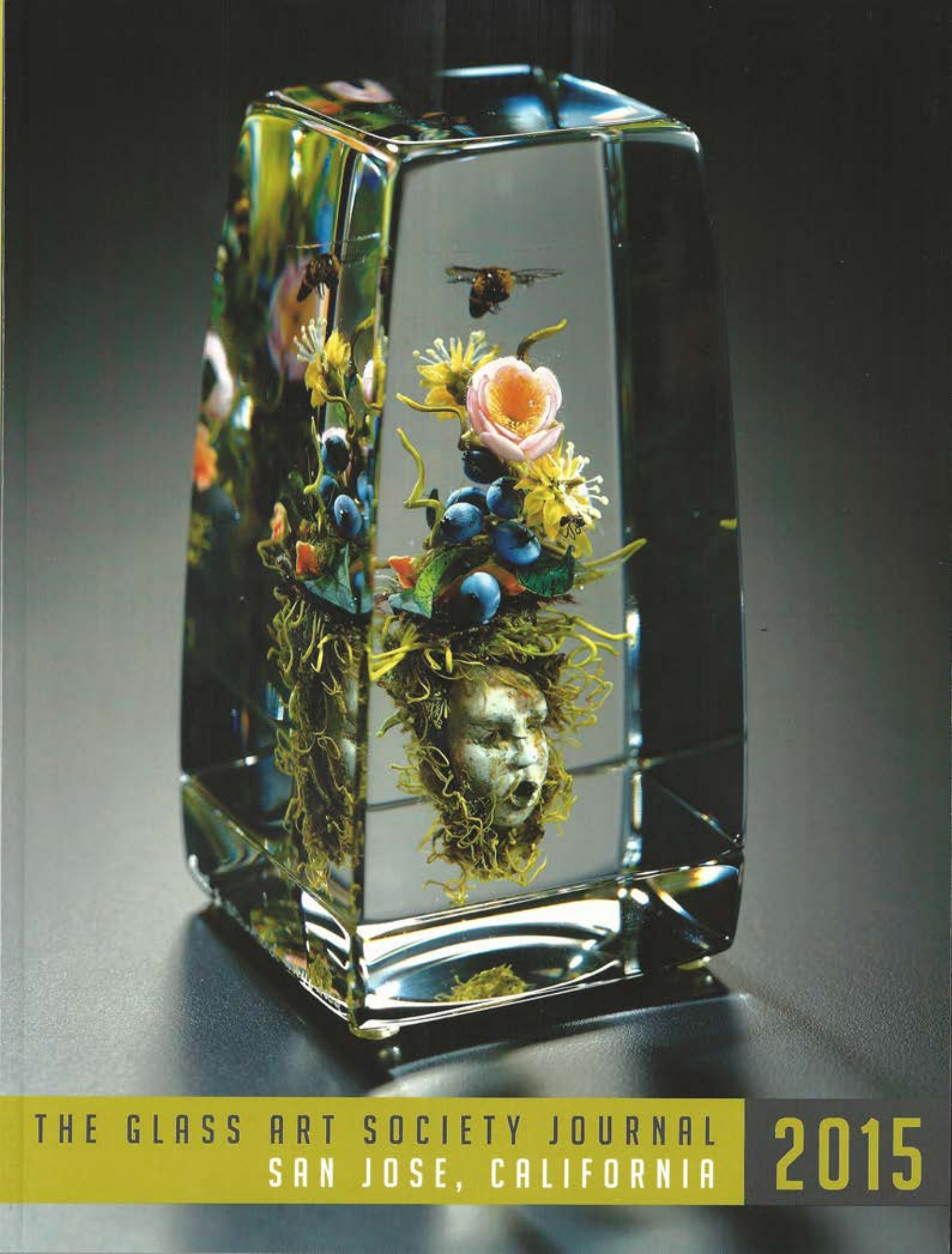

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Mastering the Void

By Joanna Manousis

During my lecture and demonstration at the 2015 Glass Arts Society conference in San Jose, I presented two distinct refractory mold-making methods to achieve residual details within solid, kilncast glass. As a starting point, I highlighted various sculptural objects and installations from my own portfolio that had been fabricated using "core" molding strategies, namely, "hanging-core" and "surface-core" molds.

Core molds are fabricated by installing a positive refractory form (the detail that you wish to imprint as a negative space), inside a refractory mold that has the volume and shape of the final glass casting.

These mold processes require a cast refractory core, taken from a rubber mother mold. The core is incased inside a hollow wax form (for hanging-core) or clay form (for surface-core); glass will eventually take on the volume of the clay or wax. When the refractory core is suspended within either of these two mediums, the positive is sprued, vented, and treated in the same way an object would be prepared for a traditional hand built refractory mold.

Ultimately, glass is cast into the mold, circulating around the refractory core but not penetrating it. Once cast, the refractory core is carefully removed using forged metal tools and a dental Waterpik, thus leaving a void within the glass that is fully revealed when the surface of the glass is polished.

The Specifics of the Hanging-Core Mold Process

The hanging-core method is essential for large castings and for cores that have a height that exceeds its width. Also, refractory cores that have protruding surface details (like a birds beak) should be handled using the hanging-core technique.

If you are new to this process, I would suggest selecting an object for a refractory core that is simple, without slender details that may snap off when removing the core from its rubber mother mold. Refractory material is extremely brittle, and thin details with undercuts may not withstand the removal process from their rubber mother mold. Wax, in contrast, has elasticity and shrinks slightly upon cooling, making it considerably easier to remove from a rubber mold.

The removal of the refractory core after the casting process should also be considered.

Joanna Manousis, *Distilled Portrait I*, 2012, cast crystal, mirror, stainless steel, taxidermy magpie, 16 x 6 x 6"
Cast using hanging core refractory mold.

It is difficult to extract a core that has a height that exceeds your average forged metal or wood tool. Sometimes the maker has to be inventive, creating tools out of bent steel wire that will reach a particular crevice or angle to remove the investment material from the glass.

I create refractory hanging-cores using a two-part rubber mother mold. Before pouring the refractory into the rubber mold, I add lengths of threaded metal rod or kiln wire inside the cavity. These metal armatures ultimately help anchor the hanging core to the final refractory mold and help stabilize the core when the mold undergoes the wax steaming process.

The refractory core is installed within a wax shell that has the formation that will eventually be solid glass. I cast the hollow wax by means of a multi-part rubber or hydrated plaster refractory mold. Molten wax is poured into the mother mold and left to cool for approximately 10-15 minutes. The remaining hot wax is then poured out, leaving a wax sleeve inside the mold.

After the wax shell has cooled completely, a window is cut out of the shell to provide visual access when installing the hanging-core inside the wax form. I support the core inside the hollow wax with surplus wax strips. When I am happy with the situation of the core, I adhere it to the wax strips by applying slightly cooled wax around the core. Once the core is set, the wax window cut-out can be replaced and adhered with a heated metal tool.

The cavity of the hollow wax is filled with surplus wax to ensure that the core will not dislodge during the handbuilding mold making process. I suspend the hollow wax shell in a bucket of cold water while I pour in hot wax to fill up the cavity around the core. The water expedites the cooling process and prevents a blow out, should any wax escape from the seamlines around the wax window.

Once the solid wax is completely cooled, the form can be vented and sprued, as you would set up a regular wax form for a refractory mold. I hand build my mold with three layers of refractory. The first two layers are comprised of 1:1:1, water, plaster, silica and a few tablespoons of fiberglass strands. If my wax form exceeds a width of five inches, I wrap the second layer in chicken wire before then applying a final coat of refractory, mixed with the addition of coarse grog. I aim to have a wall thickness of at least two inches on my larger molds.

After the mold material has cured, the wax must be steamed out immediately. Following steaming, I pre-fire my molds and bring them slowly up to a temperature of 1100 °F to remove physical and chemical water before I charge the glass for casting. This helps to prevent veiling between billets. I fire the molds with an annealing schedule that includes the thickness of the glass and core. For example, if my core is three inches and the thickness of glass surrounding it is two inches, I set a seven inch annealing program.

The Specifics of the Surface-Core Mold Process

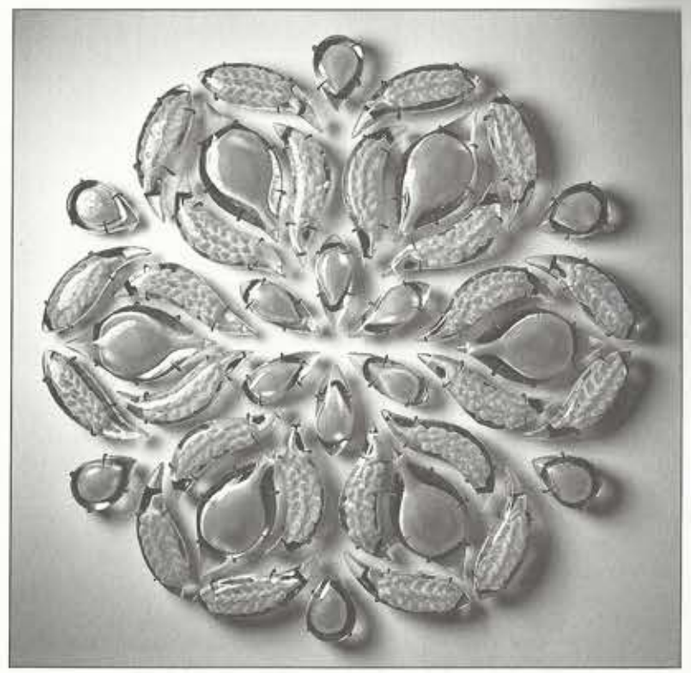
Surface-core molds are best utilized for refractory cores that have a width that exceeds its height and for negative details that are simple, with no protruding details. For example, *Demeter's Rose* is a multi-part wall installation comprised of crystal segments that were cast using surface-core molds. The negative spaces of wheat kernels and spherical formations are shallow and wide.

The surface-core method requires a rubber mother mold that contains the details of both the core and the bottom surface of what will be the refractory mold. A mix of 1:1:1, plaster, silica, and water with the addition of chopped fiberglass strands are poured into the rubber mother mold. Once set and removed, clay (rather than wax) is formed around the refractory core, in the volume and shape of the final glass casting. A clay sprue is then applied to the clay volume surrounding the core. This will act as a reservoir for the glass during the casting process.

A release agent, such as Vaseline, is applied to the perimeter of the refractory mold, surrounding the clay. A handbuilt refractory mold is made in one thick layer around the clay's volume. Once set, the two sides of the mold are split apart, the clay is removed and the mold is cleaned of any clay residue.

Finally, the two halves of the mold are put together again, and a mix of refractory with a high fiberglass strand content is applied around the seam line of the molds two halves, thus sealing them together and making them ready for firing.

Core molds provide a beautiful satin-like surface within cast glass, which is fully revealed when the exterior of the piece is optically polished. Ultimately, the cast surface within the glass reflects light, giving the residual textures an ambient glow. The optics of the negative details created from the core can be transformed aesthetically by the way that the glass is ground and polished. For example, grinding a concave lens will visually contract the negative space, whereas a convex surface will enlarge the details of the core.



Joanna Manousis, *Demeter's Rose*, 2015, cast crystal, steel, stainless steel, 58 x 58 x 4"
Cast using surface-core refractory molds.

Clay bed with a diameter that allows for the core, thickness of glass, and the mold wall.

After the refractory is poured, cured, and removed from the rubber mold, clay is modeled around the core details. This will ultimately be the shape of the cast glass.

Joanna Manousis was born in Britain and lives and works in the US creating works in glass and mixed media that speak of human emotion, memory, and the passage of time. She holds an MFA in sculpture from Alfred University and a first class honors degree in glass from the University of Wolverhampton, England. Manousis has worked, studied and taught in Japan, the United Kingdom, and the US. Manousis' work can be seen in permanent collections at the Glass Museum Ebeltoft, Denmark, the Coburg Glass Museum, Germany, and the Cafesjian Center for the Arts, Armenia.