Spirited Skies project
Silica Aerogel in Art and Design Applications
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Abstract
This comparative study on two interdisciplinary artistic practices aims to improve public perception of scientific research and to facilitate informed decision making regarding climate change and how it affects everyday life. It also hopes to break down (or bridge?) the isolated silos of Art and Science, by emphasizing the role of imagination as a tool of creation and innovation in the new economies of the 21st Century. Notwithstanding the ephemeral appearance of the super-light silica aerogel used by Michaloudis in his sculptures, the longevity of some of his art seems guaranteed: two works, Bottled Nymph and Noli Me Tangere have been selected to be rocketed to the moon as part of the MoonArk sculpture. The sculptures will be aboard a Space X Falcon 9 rocket launched in 2018 from Cape Kennedy in an Astrobotic Robotic Lunar Mission, and will remain on the moon, potentially, for billions of years. Spirited Skies is a project where we experience by touching other forms of longevity of the ephemeral silica aerogel. Filling double jacketed borosilicate glass vials with aerogel skies and clouds in a unique way, Michaloudis transforms every day’s life trivial objects into art. And whilst Michaloudis is seeding the heavens and landing his artwork onto the moon, a Masters student under his supervision, Matthew van Roden is waxing and waning back here on earth. Van Roden’s material of choice is wax, which he pushes through various artistic disciplines to extrapolate its flesh like qualities.

Introduction
The primacy of materiality has always underpinned creative practice throughout history. The artist has always in some way sought to master the material, be it marble, clay, an almost endless array of bound pigments applied to differing surfaces; all producing singular effects. Innovation for creative practice is in finding new technologies for employing materials, discover new materials to use, and exploring the way in which presenting those materials creates new meanings. This fundamental connection of materiality and meaning reveals something of our nature as meaning machines and of the role of the artist in developing ‘technologies of meaning’. Materials speak to us. Their properties convey value; they give us information about our place in the world and draw out our desires.

Silica aerogel is a nanomaterial considered by Michaloudis as the incarnation of meaning. Its immateriality drives the authors to measure it not as a tangible material. And it is not: it is not like other conventional foams, but is a special porous material. This exotic substance has many unusual properties, such as low thermal conductivity, refractive index - in addition to its exceptional ability to capture fast moving dust, cf. Stardust project. Silica aerogel is made by high temperature and pressure supercritical point drying of a gel composed of colloidal silica structural units filled with solvents. Aerogel was prepared and flight qualified at the NASA’s Jet Propulsion Laboratory (JPL). JPL also produced aerogel for the Mars Pathfinder and Stardust missions. This particular JPL-made silica aerogel approaches the density of air. Silica aerogel is resilient and easily survives launch and space environments.
In many ways artists are and have been defined by the materials they use; new movements often born from breaking conventions around their use. Ioannis Michaloudis has a creative practice that for the last 16 years has focussed on harnessing the properties of silica aerogel. Despite its namesake, it is actually dehydrated foam and ranks amongst the lowest density substances known. Michaloudis is the first artist to employ aerogel as a sculptural medium. Matthew van Roden is a visual artist working more with wax, in particular beeswax. A material with an ancient connection to artistic practice and embraced by the artist for its flesh like properties.

Silica aerogel: a queer’s sky incarnation

Silica aerogel is indeed a remarkable substance; some 99% air and 1% glass. A particular JPL-made silica aerogel approaches the density of air. Aerogel is remarkable not only for how it is and what it is. Aerogel is remarkable also for its strangeness, its aesthetic queerness; what it evokes in the beholder; how it appears. To hold a ‘lump’ of silica aerogel in one’s hand is an unnerving experience. Immediately, its conspicuous un-lumpiness is exposed. A material unlike anything else one might have held before, sparing perhaps candy-floss? At least until the spun sugar melts to the fingers; a reminder of its ‘thingness’... There is a slippage between the visual sense of seeing the silica aerogel between one’s hands and feeling not much at all, an unexpected density; something so light and strangely intangible for an object being held.

Outside of the scientific realms where the race is on to test the outer limits of aerogel’s abilities and commercial viabilities, a space has also carved itself out within popular culture. Youtube is awash with videos spruiking the powers of this innovation; its applications in space research; its affiliations with NASA; its availability on ebay, and so on. Small samples can be purchased so you can experiment with your own piece of sky.

It is the sky-like quality of aerogel that has most captivated the hearts and minds of the lay nanomaterial enthusiast. Against a black backdrop the mysterious substance glows blue like the earth’s very own atmosphere, and does so for much the same reason. In India is has been referred to as “frozen smoke”. Nevertheless, with a light passing through its translucent body, it can glow orange as a sunset. Dr Ioannis Michaloudis happened upon this magical substance much by a “happy synchronisation” in 2001 whilst conducting postdoctoral research at MIT. The sense of a sky, trapped, captivated his imagination, the feeling of touching heaven in this ‘almost nothing’ material; a substance so intriguing, beguiling and ethereal it set him on an obsessive course for the best part of two decades. It is no coincidence that the first of Michaloudis’ aerogel sculptures (fig. 1) took on the myth of Icarus as its subject matter; the famed story of the son of master craftsman Daedalus who constructed for his son a pair of wings from feathers and wax in order to escape Crete and the oppression of Minos. Daedalus has also made himself a pair of wings and tested them before his son took flight. When fleeing the island, he warned the young Icarus not to fly too close the ocean nor the sun, but to follow only in his trail of light. However, the foolhardy boy drunk on the feeling of both liberation and flight soared in the heavens, too close to the sun and melted the wax bonding the feathers to his body; plunging eventually to both the sea and to his death. Michaloudis finds in his first encounters with aerogel the ecstasy of Icarus. Through this material, he soars into the heavens and touches the sky.

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1 The same optic phenomenon – raylight scattering – explains why our sky is blue, as behind it lays the darkness of space.
Wax: fire in the sky

Wax as a material is an integral strand to Matthew van Roden’s creative practice, he uses it as encaustic (wax base for powder pigments, as a ground on which to print or transfer drawn material, then to encapsulate collage, sculpturally and recently as plate for various types of printmaking techniques. He found wax to be an innately queer material; it is a material that exhibits a remarkable strangeness. Transitioning from solid to fluid and back again infinite times over; absorbing, holding and repelling; simultaneously archival and volatile; a material always in a state of immediate potential for movement, change and flux. Wax is a material often used for representing or in some other way ‘standing in for’ flesh. Covering the cold surface of the ancient Greek marbles, the painting of the early Byzantine icons, the spectacle of celebrities mediated through the wax museum; wax has always been a material for the embodiment of venerated objects and subjects. Like flesh, wax can melt, crack, burn, sweat, hold pigment; more esoterically, it can be purified, consecrated, broken. Van Roden is interested in this ‘flesh-like’ or ‘skin-like’ quality of wax. How it can speak of and to flesh. Wax is super sensitive to the application of heat, which proves both weakness and strength. ‘Lost-wax’ is a casting method whereby a wax cast is placed in a mould and heated until the wax is ‘lost’ and a metal such as gold, silver or bronze can be cast in the empty space. Van Roden likes to experiment with the idea that instead of wax being lost, it is celebrated as the kept material. With an average melting point of around 63°C beeswax isn’t as stable in terms of its resistance to heat as an artist might like in terms of ensuring its longevity as an artwork. Traditionally beeswax has been mixed with Dammar resin to harden it and raise its melting point. Dammar resin is quite yellow however and van Roden prefers to add castor wax at a ratio of 1:4. Castor wax is clear and has a melting point of approx. 80°C. This hardens the beeswax without affecting the colouring.

Density of transparency

As already stated silica aerogel has an extraordinarily low density, averaging at 0.1 g/cm³. Its lightness is ethereal, and a property that Michaloudis wields to his advantage, incorporating in strange an in between spaces. In his recent work, Spirited Skies (fig. 3) Michaloudis injects a double jacketed borosilicate glass vial with silica aerogel. A delicate ladder traces through the cloudscape to a flake of gold leaf. The glass vial is filled with wine inviting the viewer to drink in the sky, to imbibe, to take a journey up Jacob’s ladder. In this work the internal atmosphere of the double jacketed glass, filled with wispy aerogel is a seemingly impossible skyscape; dreamlike and ethereal. Just a Jacobs dream the ladder points to the connection that the aerogel gives us to our own sky; a connection between heaven and earth.

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2 The first book of the Old Testament, Genesis 28: 10-19 tells the story of biblical patriarch Jacob who whilst fleeing from his brother Esau falls asleep on a rock. In his dream a ladder appears and angels ascend and descend to and from the heavens and the voice of God assured Jacob of his blessing and his future.
The periodic table provides a more or less comprehensive list of the entire possible stable naturally occurring and hither unto synthesised chemical elements possible in the universe, according to their atomic structure and weight. It tells us what there is elementally in the world, but and perhaps more importantly provides the rules for why things are and how we can predict how they will behave; not just here on earth, rather anywhere in the known and yet to be discovered universe. This allows for a movement in our understanding that is strange in the way that it is simultaneously expansive and collapsing. In one direction, we can spread our knowledge of the fundamental underpinnings of the constructs of materiality over everything that can be known to exist; this knowledge can be taken as universally true. On the other hand, it collapses the separation of the heavens and the earth; it insists that what we are is much the same as what everything that can be known is. That distance is the only thing that separates one magnificent location from another, though what constitutes the make-up of any two locations is more or less governed by the same sets of rules and can be predicted accordingly. Analogously, what Michaloudis discovers in his encounter with aerogels is similar. On the one hand, it projects him into space, and on the other it collapses the celestial right down to the ground. It reveals the present-ness, the right here-ness of the sky; that we are already in the sky, that the heavens are a place on earth.

In terms of density, beeswax averages at around 0.96g/cm³. Whilst not exactly heavy per se, you really feel it in your hands and it provides a stark contrast the ephemerality of the aerogel. Whilst aerogel is some 99% air, wax is 100% wax with no air at all. It is this quality that makes wax a perfect medium for the incorporation of collaged elements. In the artwork You are my sister (fig. 2), wax encloses thin layers of tissue paper and cardboard lettering they are encased within layers of wax medium, penetrated in fact by the wax when in its liquid state. The wax renders these fragile collaged elements stable and waterproof, incorporated into the medium, after which a graphite drawing is transferred to the surface.

**Noli Me Tangere: the tactility of meaning**

Both silica aerogel and wax have interesting tactile properties. Both evoke a haptic response in the viewer; evoke a desire to touch. Van Roden exploits these tactile qualities through his use of wax. In this case, it is not the alien nature of the material that draws in the viewer, rather, its familiarity. A familiarity that operates on two fronts: firstly, wax is a completely domesticated material, incorporated into many parts of our daily lives. Candles are the clearest example of an everyday use of wax. Seeing this material used in a completely different way excites to the user to touch the material in a different context. Secondly, van Roden believes that there is a natural and strong association between wax and skin. Wax has flesh-like qualities that draw the viewer in and evoke a desire to touch.

Aerogel is a strange substance, unfamiliar, alien. Scientific development of silica aerogel reveals it as a peerless insulator, with applications that extend from spacesuits and ships to clothing and architecture here on earth. It is a material that can help manage our reliance on energy resource intense cooling and heating. Michaloudis’ silica aerogel sculptures presents themselves as almost not there. When they are encountered, particularly for the first time, the viewer is compelled to touch it, to know it. It is a substance that excites curiosity and projects mystery. In much of Michaloudis’ work, aerogel is captured and contained within glass there is protective layer between the viewer and the cloud. In his interactive work My first time I touch a cloud (fig. 4) Michaloudis invites an audience to interact with his aerogel sculptures, to touch them and experience as he did the ecstasy of Icarus, touching the heavens for the first time.
The viewer is invited to insert their fingers through an acrylic slit, a wound-like opening behind which the aerogel is suspended. In the same way that the aerogel appears only just there, it can only just be touched. Michaloudis video records these interactions some of which are frustrated and almost violent in nature. As the viewer is experiencing the fragile, ‘only just’ physicality of the work a Morse code alert of S.O.S blasts out heralding a prophetic message of a touched sky in crisis. The purpose of the work, mediated specifically through the materiality of the aerogel is to warn viewers as to the impending troubles that are befalling the planet even as we speak and call to action in each individual a personal reflection and response. For Michaloudis, Save Our Souls is transfigured into Save Our Skies! The evidence is clear, the sky has indeed fallen, we can now hold it in our hands, this immaterial thing has materialised and we bear witness to it. He understood this same material as an allegory of a challenged and breaking atmosphere due to our human, energy resource intense needs and desires.

**Conclusion**

For both Michaloudis and van Roden, materiality is a primary concern. Pushing their material of choice in directions that sit outside the norm creates a “kind dynamism” in the work, drawing out this quality of desire in the viewer; an immaterial-material meaning. Interdisciplinary artistic research is breaking down silos between Art and Science by reintroducing imagination as a tool of unlimited creation and innovation. These artworks aim to bridge the link between the materiality of art and material science and replicate the inexperienced, unknown of space into a tangible engagement here on earth. The artists here understand our wounded sky not as a disaster, but as a latent re-creation. They observe the manifested catastrophe of Earth’s atmospheric garment, through creative practice and research; they are raising awareness of our atmosphere, this last layer/breath of our planet, which is suffering from excessive human action - industrialization and overconsumption.

**References**