

Aesthetics and nanostructure

ION BEAM IMAGE
OF THE ROOT OF A
HUMAN HAIR WITH
10 NM THICK GOLD
COATING, PREPARED BY
IMPACT COATING INC.

NANOFORM

Professors Cheryl Akner-Koler and Lena Tibell of the NanoForm project describe the artistic methods and benefits that it might afford to both science and society



Could you define the general aesthetic approach used in this project?

CAK: We use an applied aesthetic approach that emphasises how sensory input influences the active process of creating a gestalt and/or making discoveries. It is a professionally orientated definition that puts aesthetics in an engaged and creative role rather than a passive and appreciative role. We recognise how our different senses interact with each other and refute the division of our senses into higher or lower categories aiming to emancipate haptic, tactile, smell and taste. Our approach also critically questions the idea of a universal beauty and instead accepts the entire spectrum of human sensory experiences.

In the present projects we have driven workshops that have shown how haptic aesthetic reasoning is developed by professionals within art and design disciplines. These workshops awaken aesthetic sensitivities for sharing immediate experiences and introduce analytical concepts that embrace these sensitivities. Offering the scientific community insight into artistic research methods that rely on sensory experience is a priority of the Swedish Research Councils. Applied aesthetic education should be on the agenda for education and research institutes that deal with discovery and innovation beyond simple systemic thinking.

What are some of the challenges of applying an aesthetic approach to nanostructures?

CAK: Our major challenge is to find ways to involve the body in explorative interactions with the nanoworld, a world that is far beyond the

direct sensation of touch and human interaction. To overcome this challenge we formed two teams early in the project that used an aesthetic approach on two scales: nano and macro.

The nano team collaborated with researchers from Albanova Nanofabrication Center (NanoFab) at Stockholm University. Rudimentary geometric and archetypical test-probing experiments were made to develop a sense of scale and support narrative ideas from the macro workshop.

The macro team worked in a more individual way to develop workshops. The activities in the workshop are called aesthetic laborations, which are exploratory studies in multi-disciplinary lab-sessions inviting participants to interact in experiments set up by a leader. An aesthetic laboration is conducted in a playful, hands-on way involving probing, perturbing and interacting with materials and tools.

The method is rooted in a cooperative inquiry method that engages participants as co-researchers and serves as an alternative way of performing explorative experimentation that complements and challenges the classic methods of performing scientific lab sessions. The important idea behind aesthetic laborations is that they are based on the background and particular interest of a participant that might help others understand the project theme. We have so far conducted five workshops with 14 aesthetic laborations.

How does your work benefit from multidisciplinary collaboration? What are some of the fields represented by your project contributors?

CAK: The most important benefit of working with a multidisciplinary group is in maintaining a broad perspective as we progress through the project. The group is made up of professionals working in creative industry, fine arts, academic teachers and university-based researchers that come from the aesthetic disciplines, learning sciences, as well as life and natural sciences.

The project is managed by a small group who organise the activities and act as artistic leaders and navigators. Yet every participant has the possibility of leading an activity based on how they interpret the two-fold theme: nano and/or haptic. The project is therefore open-ended and innovative, allowing for spontaneous changes that are shaped by the participants in the group.

How do you see the fields of nanotechnology and haptics developing in the future?

LT: An emerging viewpoint of cognition suggests that the body has a central role in shaping the mind and that cognitive processes are deeply rooted in the body's interaction with the world. By using haptics, force feedback and physical interaction we can get a 'feeling' for intermolecular forces and nano structures which supports a more engaged embodied understanding of chemical biology. In the near future we should see more support for the haptic learning experience in biochemistry, because it improves cognition by transferring mental computations (ie. representations) from our hands to our minds and maybe also vice versa. New types of virtual haptic feedback representations could be developed by studying artists and designers' ways of using their hands and bodies in complex creative situations. One interesting research area that is developing is in epistemic actions, which is about the actions used to support the meaning-making and planning processes.



Infinitesimal intricacy

The innovative **NanoForm** project seeks to provide an aesthetic approach to develop human sensitivity to the intangible nanoscale by interacting with and creating and interacting with nanostructures

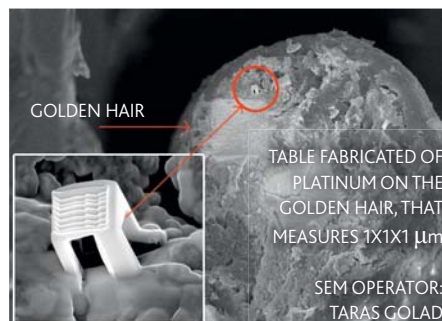
FROM RUDIMENTARY BEGINNINGS in the early 1980s, to fundamental integration in a diverse range of applications, nanotechnology is a field that has experienced a phenomenal amount of growth in an extremely short period of time. However, many significant questions hang over this technology, with its importance and potential remaining intangible to many.

The nanoworld defies the sense of touch that is so integral to the way we interact with the world around us. Touch involves experiences of texture, pattern, temperature and vibration and allows us to define objects. Yet, when touch involves intentional muscle movement, such as picking up and using a tool, we transcend touch and enter haptics – sensory experiences that stimulate our nervous system and induce base-level reactions and emotions, such as push and pull, pain and pleasure.

Haptics has been integral to recent developments in healthcare technology, robotics, and the design of novel computer interfaces. This technology has also begun to play an important role in the interactivity of art and design, supporting artists to have mediated contact with virtual instruments that produce real-time events on a nanoscale that are responsive to human interactions.

TOUCHING ON NEW GROUND

NanoForm, an ambitious project conducted by the Grythyttte Academy in Sweden, seeks to explore the relationship between nanostructures and haptics to determine its use and importance in creative processes, as lead researcher Professor Cheryl Akner-Koler explains: "In a recent review of the field, haptics was defined as the most



varied of scientific disciplines. However, the use of haptic experiences to support the creative gestalt process in art, crafts and design was not covered". She continues: "This project can thus benefit the development of the field of haptics by adding new perspectives from the holistic gestalt process used within art and design. By sharing

By creating nano-level artefacts, we were able to develop a way to physically relate to nano scale, stimulate our curiosity and develop a number of stories that give coherency to our work

how haptics supports the gestalt process for professionals, such as sculptors and sommeliers, we will also strengthen artistic research in the field of aesthetics and formgiving".

The project sees Akner-Koler and her team exploring nano features in order to influence innovative form creation. While sculptors have been able to translate

a shape from an initial concept into a physical form through haptic actions since the dawn of civilisation, today's advanced nanotechnology enables us to extend this haptic sense into the virtual world, creating, for instance, a sense of weight for a virtual object. This has proved to be an essential tool in the development of new technologies for the scientific community, offering revolutionary applications for remote surgery with unprecedented levels of touch, grip and delicacy.

LACED WITH INNOVATION

To demonstrate the power of this field, the NanoForm researchers have developed and implemented an innovative scale interlacing method that enables organic matter, such as human hair, to be directly coupled with nanotechnology. In the first demonstration of this technique, hairs ranging from 60-80 micrometers (μm) in thickness were coated with a thin layer of gold at Impact Coatings Inc., to induce the electrical conductivity required to construct forms at the nanoscale. This was then used as a platform



WORK STATION FOR THE SCANNING ELECTRON MICROSCOPE AT ALBANOVA

INTELLIGENCE

NANOFORM

NANOFORMGIVING THROUGH HAPTIC AESTHETIC LABS

OBJECTIVES

Developing interdisciplinary artistic research methods is the overall objective of this project. A central method is in the further development of aesthetic laboratories, which is a playful, sensory based, collaborative activity for exploring phenomenon on two scales: nano and macro.

PARTNERS

Örebro University, ÖU, Grythytte Academy, Hospitality, Culinary Arts and Meal Science, Sweden • **Stockholm University, SU**, Albanova, Nano Fabrication Center, Sweden • **Linköping University, LU**, Biochemistry and Life Science Education Research, Sweden • **Konstfack University College, KU**, Dept of Industrial Design, Stockholm, Sweden • **Chalmers University of Technology, CU**, Dept of Architecture, Göteborg, Sweden • **Massachusetts Institute of Technology, MIT**, Boston, USA

KEY COLLABORATORS

Co-artistic leader **Arijana Kajfes**
Nano-Scientific leader **Narendra Yamdagni**
Media navigator **Katarina Eismann**
Design leader **Teo Enlund**

Workshop leaders:

Björn Norberg, Mischa Billing, Gustaf Mårtensson, Lena Tibell, Nalle Jönsson

Participants:

Fredrik Berefelt, Annika Göran-Rodell, Ebba Matz, Monica Billger, Christina Bohm, Edith Ackermann, Catarina Dyrssen, Erik Borg, Ulrika Henricson, Lars Bergström, Petter Bivall-Persson, Parivash Ranjbar, Lena Lorentzen, Anders Skogh

FUNDING

Swedish Research Council – Artistic Research section

Albanova, Nano Fabrication Center, Stockholm University, Stockholm Sweden

CONTACT

Professor Cheryl Akner-Koler
Project leader & Co-artistic leader

Örebro University
Grythytte Academy
Hospitality, Culinary Arts and Meal Science
Box 1252, 701 12 Örebro, Sweden

T + 46 8450 41 00
E cheryl.akner_koler@oru.se

www.cherylaknerkoler.com

CHERYL AKNER KOLER is Guest Professor in Applied Aesthetics at Grythytte Academy at Örebro University, Sweden. She is also a Professor in the Department of Industrial Design, Konstfack University College of Arts, Crafts and Design in Stockholm.



to create a rectangular table from platinum that measured just $1 \times 1 \times 1 \mu\text{m}^2$, with 4 table legs that ranged from 250-100 nanometers (nm) utilising a Scanning Electron Microscope (SEM). The legs of this table were constructed on a scale that is smaller than the thickness of a single light wave, demonstrating how a simple and recognisable image – such as a table – could be transferred into the nanoworld, providing an insight into the depth and detail that can be attained at this scale.

FORMING AN IDEA

Elaborating on this study, and guided by Narendra Yamdagni, the NanoForm team applied bacteria from human saliva to the golden hair to investigate the concept of infectious form-giving and the process of self creation. They found that only the common staphylococcus bacteria bound to the golden hair. A second layer of golden coat was then applied to the organic bacterial matter and inspected using the SEM. Through a process of trial and error, they eroded the surface of the bacterial polyyps to investigate the properties that had caused the bacteria to form spheres. This has offered a unique insight into the interface that occurs at nanoscale between organic and inorganic materials, and also demonstrates the intricacy with which nanotechnology can be manipulated to provide an insight into the most minute of biological structures, as Akner-Koler explains: "By creating nano-level artefacts, we were able to develop a way to physically relate to nano scale, stimulate our curiosity and develop a number of stories that give coherency to our work".

PRESENTING TANGIBLE RESULTS

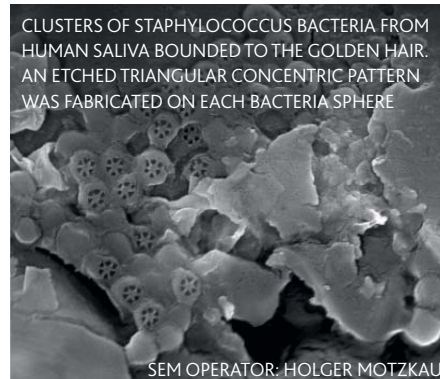
With the increasing prominence of nanoscience and nanotechnology in our everyday lives, it is fundamental that we all understand its function, limitations and application. However, this is an incredible challenge due to the complexity of field and physical and economical barriers. This presents an issue for many researchers working in the field of nanotechnology, as it can be extremely difficult to demonstrate the impact that their research will have.

The NanoForm group has adopted an innovative approach to disseminating the results of their studies. Rejecting the traditional forms of exposure, they will present their work in the form of an artistic exhibition, accompanied by videos documenting their research and workshops to date. Arijan Kajfes, co-artistic leader, believes that sharing this nanoworld with the wider

public is fundamental to encourage more social awareness of what is going on in nanotechnology: "The format of a public exhibition, as it is used in the arts, is far more accessible to the general public than the scientific exposure methods," he says. "The coming exhibition enables the general public to develop a deeper understanding of nanoscale and become more creative in relation to the nanoworld." The exhibition will be developed in collaboration with the Visualiserings Center in Norrköping, Sweden in 2012.

SOME FORM OF CONCLUSION

With the NanoForm workshops proving to be of great interest to both the scientific and artistic communities, as well as providing proof of concept for this unique interdisciplinary project, the team are keen to further explore the relationship between nanotechnology and haptics in the near future. Project partner Lena Tibell believes that this would be of great benefit to both fields and could yield a new insight into the application of haptics and how they can be developed to benefit



learning: "We would like to see more research collaboration between nano scientists and artists/designers with the aim of studying how embodied haptics are used in creative art and design. With this creative professional research approach, we could enhance our knowledge of what vital haptics experiences are about, and improve the way we interact and learn about the macro and nanoworld around and within us".

Art has always endeavoured to render and interpret our surroundings. Now, perhaps with the merging of haptics and nanotechnology, art can not only explicate life, but provide a new perspective on the intangible world around and within us.