

# RETRACTED CHAPTER: Design for Meaningful Materials Experience: A Case Study About Designing Materials with Rice and Sea-Salt

Liang Yin<sup>1,2(✉)</sup>, Ziyu Zhou<sup>1</sup>, and Hang Cheng<sup>2</sup>

<sup>1</sup> Politecnico di Milano, Via Durando 38a, Milan, Italy  
liang.yin@polimi.it, ziyu.zhou@mail.polimi.it

<sup>2</sup> Jiangnan University, No. 1800, Lihu Road, Binhu District,  
Wuxi, Jiangsu Province, China  
chenghangchloe@gmail.com

**Abstract.** Material could elicit meaningful user experiences in and beyond its utilitarian assessment. For designers, they are required to qualify the material not only for what it is, but also for what it expresses to, what it elicits from, and what it guide people to do. To find out the answer, designers need to guide the development of materials by experiential goal. In this paper, we will first introduce material experience as our theory foundation and explain the importance of meaning contribution for materials. In the design phase, we are following an innovative design practice with natural materials to create experience. The method we apply is Material Driven Design (MDD) which could facilitate designing for material experiences. In the end, we will analyze how materials experience be generated through innovative design practices.

**Keywords:** Materials experience · Meaning of materials · Material driven design

## 1 Instruction

Materials of artifacts always attract people's initial attention. In the past, we tend to discuss materials based on fabrication, application, and appreciation which dealing with the reception from users (Doordan 2003). Now we have a broader sense that corresponds with the experiences we have with the materials embodied in the artifacts around us. It refers to the mix of sensory appreciations, meanings, feelings, and thoughts that we have toward particular material (Karana et al. 2015).

Materials can not only shape products but also elicit user experiences (Karana et al. 2014) at sensorial, interpretative, affective, and performative level (Giaccardi and Karana 2015). The concept of 'materials experience' shows us that in the material driven design project, user experience could be an expected outcome. How to design for experiences with and for a particular material and how materials are expected to shape and affect the overall user experience seem to become a new research task for designers.

---

The erratum to this chapter is available at [https://doi.org/10.1007/978-3-319-57931-3\\_61](https://doi.org/10.1007/978-3-319-57931-3_61)

In this paper, we will follow the Materials Experiences theories and Material Driven Design (MDD) Method developed by Karana to present our design process with Full-natural Sea Salt named Melach, which is developed within the course of Designing Materials Experiences aa.2016/2017 by Valentina Rognoli with Camilo Ayala and Stefano Parisi. Then we will apply MDD to design meaningful experience with these materials.

## 2 Materials Experience

Materials are sensorial abundant in our daily life. If we want to look at materials from an experiential perspective, it is to establish material interactions occurring through our senses. Also, research found that according to cultures, individuals and different contexts of use, the interactions between materials and users are modulated over time (Karana et al. 2015).

Although we experience materials every day, the concept of materials experience has taken a long time to be in front of us. In 20<sup>th</sup> century, Manzini (1986) emphasized that although new materials were characterized by their functionality, designers need to understand material's potential applications, performance, and ultimate effects on users give rise to materials experiences. Then, Ashby and Johnson (2009) revealed the importance of the aesthetic experience of materials for a proper materials selection in product design. They added "aesthetic" attribute of materials to the material properties list for designers.

Finally, Karana (2014) defined 'Material Experience' as a phrase that acknowledges the experience people have with and through materials and it involves four levels: sensorial, interpretive, affective and performative.

### 2.1 Materials Experience Generation

Materials experience at sensory level has been long discussed, Zuo (2011) built up a database to find the certain relationship between physical performance of materials and emotional reaction. In recent years, the importance of people and their activities are at a premium. Giaccardi and Karana (2015) indicated the dynamic relationship between materials, people, and practices, then they built up a tri-nominal logit model of material experience (see Fig. 1). In their theory, 'practices' are considered as situated 'ways of doing' that unfold and become assimilated into an ongoing set of everyday performances.

### 2.2 Four Levels of Materials Experience

In the original description of Karana et al. (2008), materials experience consists of three experiential components: 1. aesthetic or exactly say, sensorial experience which is like cold feeling, smooth and so on, 2. experience of meaning which more related to the semantical aspect of materials, and 3. emotional experience which elicit certain emotional reaction like surprised or happy. Giaccardi and Karana (2015) extended the original definition of 'materials experience' by adding another experiential component on a performative level. The performative materials experience is generated from sensorial perceptions, ascribed meanings and emotions which all affect us to respond differently to the embodiment of a material. The performances we establish around

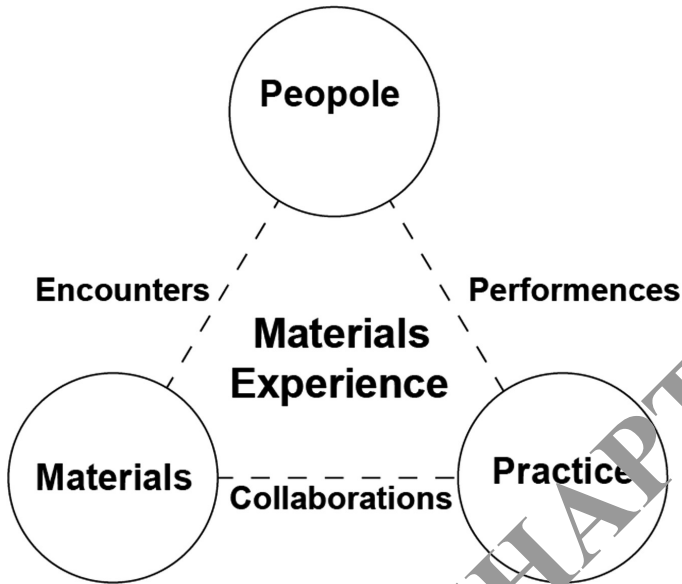


Fig. 1. The framework of material experience (Giaccardi and Karana 2015)

material objects are significantly influenced by such perceptions, meanings and affects. Furthermore, the unfolding of performance into unique and peculiar ways of doing, and their assimilation into practices, are both mediated and affected by the material character of such performances.

Karana et al. (2015) then emphasized that a comprehensive definition of ‘materials experience’ should acknowledge the active role of materials not only in shaping our internal dialogues with artifacts, but also in shaping ways of doing and practices. Accordingly, they defined four levels of materials experience as: sensorial, interpretative, affective, and performative.

### 2.3 Meaning of Materials in Materials Experience

Meaning has been taken as the relation of signs to users. The meaning of a product is constructed based on the relations between its form, function, color and all the features that compose the product (Krippendorff and Butter 1984).

Materials contain various meanings in products. Semantic functions of materials in product appraisals has been widely discussed, and the effectiveness in transferring meanings is explored, too. Karana (2009) claimed that the meanings of materials usually depends on four aspects: the type of meaning, the type of material, the product in which the material is embodied, how the product is used and user background. Designers usually attribute meanings to materials according to the characteristics of a situational whole in which certain materials are experienced. This attribution happens as an outcome of a dynamic action between the user and the material embodied in an artifact. When a user with his or her particular prior experiences comes into visual or

physical contact with the material of an artifact, appraises that material–artifact combination, and attributes meaning to it.

In materials experience, in addition to certain associative descriptions from users, it usually requires retrieval from memory and past experiences which can also express particular qualities of materials, such as toy-like, human-like. These descriptions are commonly used in material appraisals and behave like expressive characteristics.

Accordingly, meanings of materials consist of semantic and expressive associative characteristics which are used for defining the qualities of materials. In conclusion, meanings of materials are what we think about materials, what kind of values we attribute after the initial sensorial input in a particular context (Karana 2009) and material meanings are highly intertwined, subjective, time- and context-dependent attributes.

### 3 Design Meaningful Materials Experience Through MDD

How to design for experiences with and for a particular material need to be supported by a distinguished approach which is experience-oriented perspective. Material Driven Design (Karana et al. 2015) is such a method to facilitate design processes for material experience in which materials are the main driver. It is made up by 4 main action steps (see in Fig. 2) presented in a sequential manner as: (1) understanding the material:

#### Proposed Materials

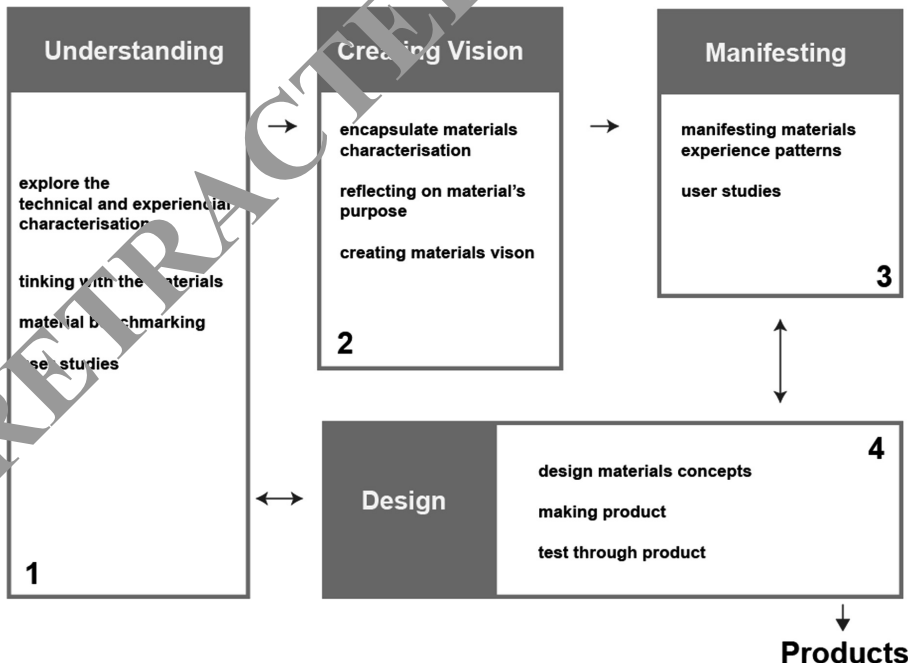
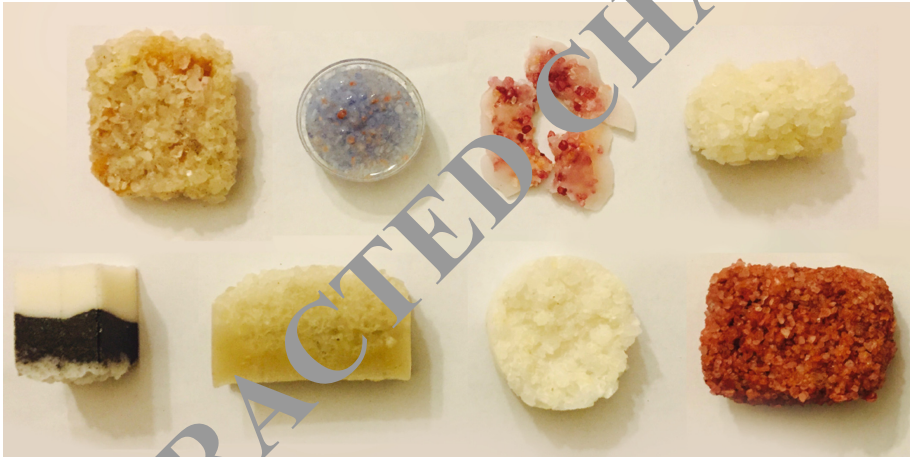


Fig. 2. The process of MDD (Karana et al. 2015)

technical and experiential characterization, (2) creating materials experience vision, (3) manifesting materials experience patterns, (4) designing material/product concepts.

We hope to design meaningful materials experience with sea-salt and rice according to this method. We choose sea-salt and rice because they are full natural resources with plastically and natural texture. On the other hand, as we use these materials on our daily life, it is easy to understand its physical and technical characters. As these materials seem hard to link to settled meanings, we need to define application areas through exploring user experiences, identities for materials, then we will have opportunities to bring new meanings to materials.

According to the material-centered interaction design theory (Wiberg 2014), we need to know which the material is approached from the perspective of the user, material properties and character and how our materials be appraised within a composition. So, we made some samples (see in Fig. 3) which allow us to make forth and back thinking about the detail of the materials. After these work, our group members had a common understanding about materials.



**Fig. 3.** Materials made by sea-salt and rice, made by Ziyu Zhou, Dajana Grubisic, Nastaran Nikaein

### 3.1 Understanding the Material

MCD method consists of several steps with the first named understanding the material that includes an extensive study of the material, with an emphasis on the experience that derives from hands-on exploration. During this step, we gained an opportunity to have a deep understanding about the material and characterized it technically and experientially in order to be able to recognize its unique qualities and limitations, improve the manufacturing process, define the position of the material among other similar ones, discover potential application areas as well as to explore the meanings, emotions and reactions that the material may elicit.

This step involved three concurrent activities of equal importance: (1) tinkering with the material during and after the process of production (see in Fig. 4), (2) material benchmarking studies (see in Fig. 5), (3) user studies. With a purpose of understanding and improving the material itself as well as the manufacturing process and the relationship between the variables of the process and expressive- sensorial properties of the material, modifications were made during process. Different kinds of binders were tested (both natural and those that are not), other materials were included, salts of various colors and sizes were introduced as well as the molds in several sizes and made of different materials.

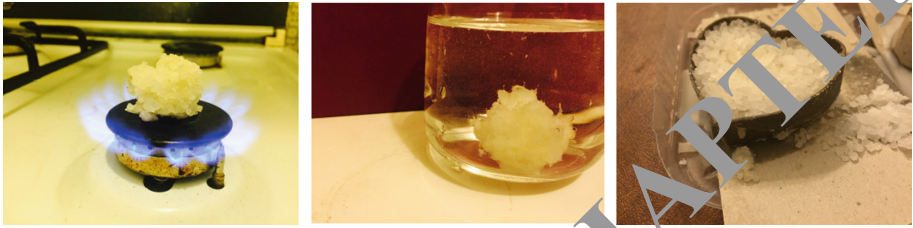


Fig. 4. Tinkering with the materials to understand the material and technical characterization








							
<b>CHARACTERISTICS OF THE MATERIAL:</b>							
Roughness	●	●	●	●	●	●	●
Irregularity	●	●	●	●	●	●	●
Natural colour	●	●	●	●	●	●	●
Hardness	●	●	●	●	●	●	●
Resistance to compressive forces	●	●	●	●	●	●	●
Resistance to tensile forces	●	●	●	●	●	●	●
Density	●	●	●	●	●	●	●
Flexibility	●	●	●	●	●	●	●
Waterproofness	●	●	●	●	●	●	●
Hygroscopicity	●	●	●	●	●	●	●
Translucency	●	●	●	●	●	●	●
Opacity	●	●	●	●	●	●	●
Stability	●	●	●	●	●	●	●
Novelty	●	●	●	●	●	●	●
Shaping	handmade and/or moulded	moulded	moulded	Crochet technique	handmade	moulded	Salt crystals were grown on media
<b>APPLICATIONS:</b>							
Architecture/building						●	
Product design		●	●	●	●	●	
Jewellery design							●
<b>EMPHASIZED VALUES:</b>							
	Handmade craftsmanship; the use of the local resources; sustainability	The use of the local resources; interpretation of typical local industries and products	authentic, engaged, sustainable material culture; value of tradition and the craftsmanship	authentic, engaged, sustainable material culture; a return to the craft	The use of locally available resources; create architecture without producing waste (closed ecosystem)	Spontaneous growing process (nature creates its own original products); personalized products;	

Fig. 5. Material benchmarking for the salt-based composites made by Ziyu Zhou, Dajana Grubisic and Nastaran Nikaein (● Low ● Medium ● High)

When the white rice was defined as appropriate binder, various ways of cooking were analyzed with the intention to determine the density and temperature that is most adequate for the process of material production. In addition, temperatures and moisture changes are also taken into consideration as the factors important for the duration of drying and the final outcome of the process.

### 3.2 Creating Materials Experience Vision

For the purpose of articulating design intent of materials, we tend to build up the Materials Experience Vision which expresses how designers envision the role of materials in creating functional performance and unique user experience when embodied in a product.

We clustered our findings and then mapped them so that we could see how they complemented each other, and how together they formed new insights relevant to the application context (see Appendix A). Based on these structured findings, we got our final vision: “We appreciate the value of little things. These little things are often exactly what we appreciate most and remember the longest. That is why we desire that the user experiences a unique and long-lasting emotional bonding with the material due to the fact that it is identified and accepted as delicate and precious, in the same way our memories, emotions and relationships are.”

### 3.3 Manifesting Materials Experience Patterns

In this stage, we tended to understand how other people experience or interact with materials. We first sought examples of the envisioned interaction from daily life, existing products and existing materials. In the following brainstorming session, we posted our feelings related to our imagination on a big map, then identified two meanings that evoke the aimed interaction as ‘delicate’ and ‘precious’ (see in Fig. 6).

In order to find patterns to evoke the aimed meanings, we adopted another supportive method named Meaning Driven Materials Selection (MDMS) which familiarizes the designers with key aspects (such as shape, user, manufacturing processes, etc.) playing an important role in attributing meanings to materials (see in Fig. 7). More important, this method supports designers in understanding other people’s understanding of preferential meanings.

With MDMS, we were approached to participate in a study with the following three tasks:

- (1) select a material according to your feeling (smart, sharp, modern, etc.)
- (2) make an imagination of the material
- (3) explain the choice and evaluate the material against a set of specially devised sensorial scales.

After analyzing the provided images and descriptions from the participants, we evaluated the result qualitatively and quantitatively.

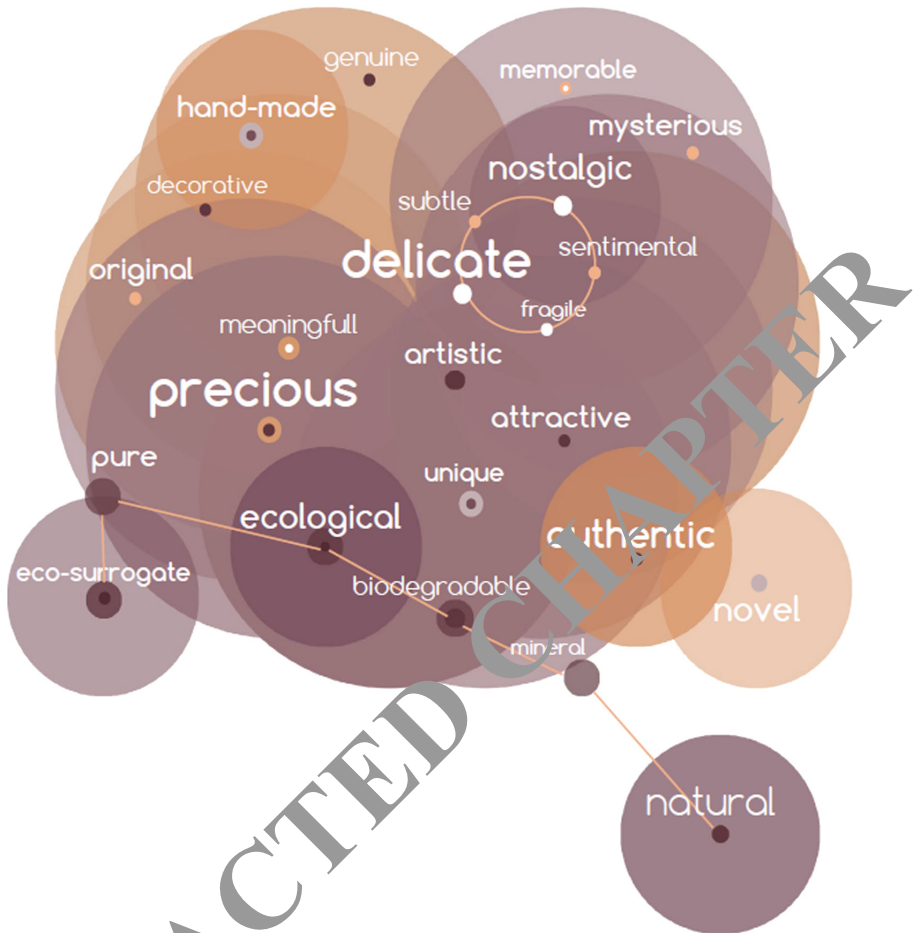


Fig. 6. Brainstorming to identify meanings

### 3.4 Creating Materials Concepts

In the final stage, we integrate all our findings into a concept generation phase. In the beginning, we created several material samples by incorporating the outcome of Step 3. Then, six promising samples that differed from each other with regard to technical properties and experiential qualities were selected to be used in the product concept creation.

In the following design process, we hope to design a product with the given material concept by using the given technical data sheet and materials experience patterns; thus, the ultimate product was expected to express the meanings 'precious' and 'delicate'. In order to give these meanings to materials, we generated several product concepts in the brainstorm phase then get some ideas of product design.

Then we further analyzed the ideas against their fit to the intended Materials Experience Vision; their feasibility which involving cost and production and their technical performance to make sure that the material can fulfill the required function. In



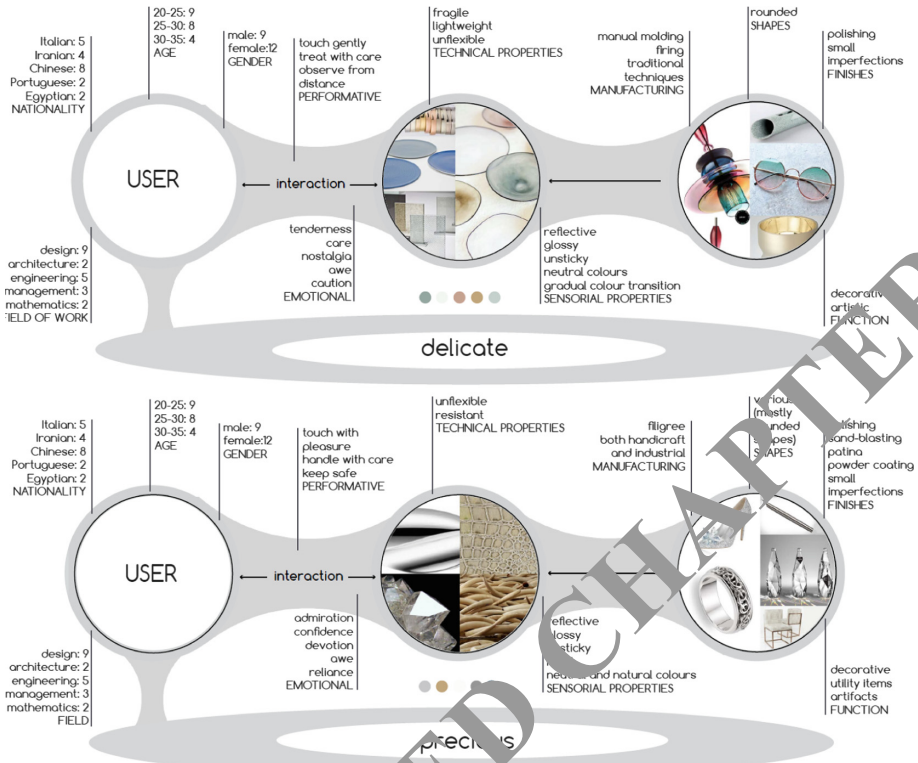


Fig. 7. Finding patterns through MDS

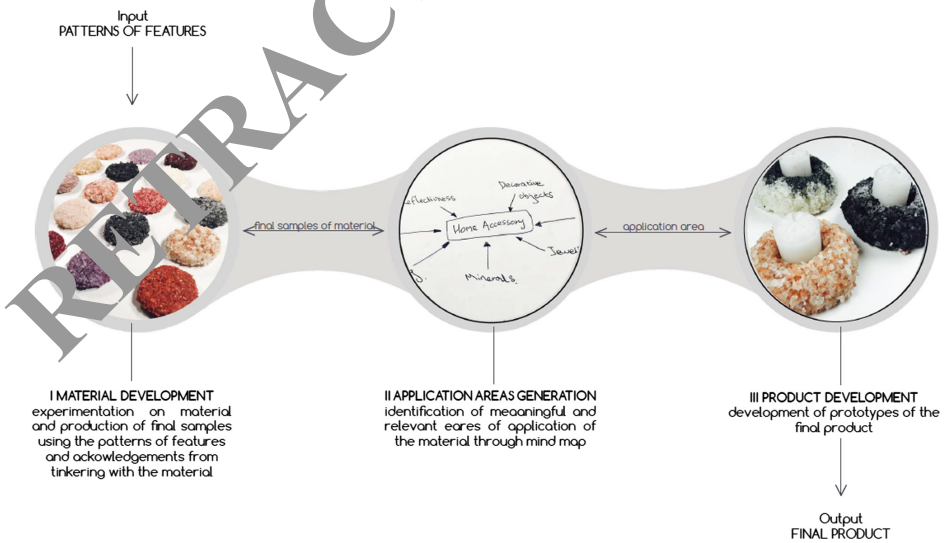


Fig. 8. Designing product concept

the product design phase, we found that what has emerged through the previous steps of the MDD Method is the fact that the most widely embraced feature of the material is its ability to reflect light. In addition, it is suitable to be applied design of decorative objects and accessory, products that are appreciated their delicacy and beauty. Therefore, candle holders as a part of the home accessory (see in Fig. 8) seem to be the most adequate solution.

## 4 Conclusion

On the basis of this research, we know that materials experience could be designed through meaning contribution while the meaning of materials should be guided under an experience-oriented perspective. Designing meaningful materials experiences requires designers to know not only the aesthetics, functional and emotional aspects, but also to understand the effects of various design aspects, user characteristics and context of use on the resulting materials experience.

MDD works well in our project as we have a deep understanding of current situation (how the material is appraised by intended users, how it is experienced on 4 levels, etc.) and fully analyzing and interpreting our research outcomes. We also realized that in the patterns manifesting process, co-design with users could facilitate concept generation as the whole materials experience design is a forth and back thinking process which user participation is needed in both four steps.

## A Appendix

### LITTLE THINGS

Belief in the value and preciousness of little things in details, in undertone and in discovery. It is still possible to impress through little things. These little things are often exactly what we appreciate most and remember the longest.



### EMPATHIC DESIGN

The definition of empathy is the ability to be aware of, understanding of and sensitive to another person's feelings and thoughts without having had the same experience. As human-centered designers, we consciously work to understand the experience of our clients and their customers. These insights inform and inspire our designs.

### UNIQUE PRODUCTS

Recent years have seen a growing trend toward unique products that contribute to individual expression or a personal sense of authenticity. Numerous studies have shown that these products may only improve customers satisfaction.

### LANGUAGE OF MATERIALS

Nonverbal communication between people is communication through sending and receiving wordless clues. In the same way materials communicate with people by providing visual cues, proxemics, haptics, chronemics or oculosics cues.

### THE POWER OF PRECONSCIOUS AND UNCONSCIOUS

The preconscious contains thoughts and feelings that a person is not currently aware of, but which can easily be brought to consciousness. The preconscious is like a mental waiting room, in which thoughts remain until they 'succeed' in attracting the eye of the conscious' (Freud, 1924).

Our feelings, motives and decisions are actually powerfully influenced by our past experiences, and stored in the unconscious. The unconscious mind comprises mental processes that are inaccessible to consciousness but that influence judgements, feelings, or behavior.

### SYMBOLISM & VALUABLE MINERALS

Gemstones have played various roles in the myths and legends of human cultures throughout history. Some tell a story or are believed to have special power, but all of them share a common beauty. Each gemstone is unique with a special color, birthstone or history. Gemstones come in every color of the rainbow and are gathered from all corners of the world, with each colored gemstone possessing a unique creation of beautiful color. Some gemstones have been treasured since before history began and others were only discovered recently.

### MATERIAL DRIVEN DESIGN

The approach through which the product design finds its meaning and connects to the experiences needed to elicit long-lasting and unique user experience.

### TASTE OF THE SEA

The salty taste is very distinguishable and possesses the ability to evoke memories on the sea. This kind of associations may only have the positive effect on the ultimate experience with the product due to the fact that pleasant environmental experiences are often long-lasting in subconsciousness.



### SENSORY MEMORY

Like all other beings, humans are also bound to explore the world by using their senses, independently or in conjunction in order to obtain knowledge about the world that surrounds them. Since their early childhood, people collect these sensorial memories and the associations they carry strongly affect the way they interpret new things and the relationships with people or objects.

### SALT: INTORWOVEN INTO ALL CULTURES

As far back as 6050 BC, salt has been an important and integral part of the world's history, as it has been interwoven into countless civilizations. Undoubtedly, the history of salt is both broad and unique, leaving its indelible mark in cultures across the globe, salt was of crucial importance economically but it has also played a vital part in religious ritual in many cultures, symbolizing purity. In short, the white granular substance we know today as "salt" has been essential to all life, especially with respect to its long and varied history.

## References

- Ashby, M., Johnson, K.: *Materials and Design. The Art and Science of Material Selection in Product Design*, 2nd edn. Butterworth-Heinemann Elsevier, Oxford (2009)
- Doordan, D.P.: On materials. *Des. Issues* **19**(4), 3–8 (2003)
- Karana, E.: *Meanings of materials*. Ph.D. dissertation, Delft University of Technology (2009)
- Giaccardi, E., Karana, E.: Foundations of materials experience: an approach for HCI. In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, pp. 2447–2456. ACM (2015)
- Karana, E., Pedgley, O., Rognoli, V.: *Materials Experience: Fundamentals of Materials and Design*. Butterworth-Heinemann, Oxford (2013)
- Karana, E., Pedgley, O., Rognoli, V.: *Materials Experience: Fundamentals of Materials and Design*. Butterworth-Heinemann, Oxford (2014)
- Karana, E., Pedgley, O., Rognoli, V.: On materials experience. *Des. Issues* **31**(3), 16–27 (2015a)
- Karana, E., Hekkert, P., Kandachar, P.: Materials experience: descriptive categories in material appraisals. In: *Proceedings of the Conference on Tools and Methods in Competitive Engineering*, pp. 399–412. Delft University of Technology, Delft (2008)
- Karana, E., Hekkert, P.: User-material-product interrelationships in attributing meanings. *Int. J. Des.* **4**(3), 43–52 (2010)
- Karana, E., Hekkert, P., Kandachar, P.: Meanings of materials through sensorial properties and manufacturing processes. *Mater. Des.* **30**(7), 2778–2784 (2009)
- Karana, E., Barati, B., Rognoli, V., et al.: Material driven design (MDD): a method to design for material experiences. *Int. J. Des.* **19**(2), 35–54 (2015b)
- Krippendorff, K., Butter, R.: Product semantics: exploring the symbolic qualities of form. *J. Indus. Des. Soc. Am.* **3**, 4–9 (1984)
- Manzini, E., Cau, P.: *The Material of Invention*. MIT Press, Cambridge (1989)
- Rognoli, V., Bianchini, M., Maffei, S., et al.: DDI materials. *Mater. Des.* **86**, 692–702 (2015)
- Wiberg, M.: Methodology for materiality: interaction design research through a material lens. *Pers. Ubiquit. Comput.* **18**(3), 625–636 (2014)
- Zuo, H.F.: *Sensory Perception of Materials in Product Design*. The Economic Daily Press, Beijing (2011)