

Research on Green Design Using New Light Medium (Bioluminescent Medium)

Hu Yue

Dalian Polytechnic University, Liaoning, Dalian, 116034, China
yueyue413@qq.com

Abstract: The emergence and development of computer technology and other advanced technologies have promoted the rapid development of society, and promoted the arrival of the new media era. This has gradually changed the traditional way of transmission and the scope of transmission. Besides, green design is also gradually affecting and changing people's living environment and lifestyle. The diversified green medium has attracted the attention of many audiences and exerted a great influence on the development of traditional medium. According to the above situation, in the new media era, the development of the field of art design is facing the need of innovation. There are two main problems in using traditional medium for design. One is that audiences gradually become numb or even bored for traditional medium. The other is that designers need to choose environment-friendly medium to carry out design work under the condition of increasing public awareness of environmental protection. Therefore, the green transformation of medium is an important issue to be faced by current design, as the same time, light medium is an essential medium element in design work. To sum up, this essay will discuss how to use new light medium for green design in the new media era, and the new light medium mentioned here is mainly the medium formed by bioluminescence.

Keywords: New media era, Green design, New light medium, Bioluminescent medium

1. Introduction

Today, in the new media era, people are gradually tired of the monotonous display and communication methods of traditional design, and even begin to reject them. Except for this, the audience's expectation for design works is not only limited to visual presentation, but also transformed into the pursuit of comprehensive experience created by different medium or modern technology, as well as the design concept or connotation of the works. This requires the design works in the new era need to change the previous concept of using traditional medium and seek a design way that is more in line with the spiritual needs of the audience.

On the other hand, the current environment we live in is not optimistic, the implementation of green design is very meaningful and valuable. At present, there are many studies on green design, but there are not so many studies on the application of bioluminescent medium in artistic design. Base on the above condition, the application of bioluminescent medium in green design is a design method worth considering by designers in the future.

This essay aims at providing inspiration and direction for future green design, so that design works can keep up with social development and promote the development of the design field.

2. Light Medium in Design Field

In the field of design, the uses of light medium are everywhere. For example, some cool light and shadow effects often appear in science fiction movies or cartoons. The light medium can also be seen on buildings or roadside lighting decorations in the night of urban. In addition, some night sculptures and night billboards also use light medium, which shows that light medium is indispensable in the field of design. The above mentioned are mostly the use of traditional light medium, but what is the new light medium? If the word "new medium" is taken apart, it is "new" and "medium". From the literal meaning, new medium can be understood as a new form of medium. So which medium belong to the new medium? First, we probably think of digital technology and web technology. These are certainly new medium, but beyond that, I think the use of bio-art for design can also be included.

3. New Light Medium (Bioluminescent Medium)

The new light medium in this article is a bioluminescent substance in addition to the traditional way of luminescence, such as the chromatophores in octopus and the light-emitting mushroom. As shown in Figure 1, some luminescent mushrooms were photographed by Alonso Cortes-Perez et al. Besides, as shown in Figure 2 is a mushroom called *Panellus stipticus*. *Panellus stipticus* is a very common mushroom growing on rotten wood in eastern North America, which gives off vitality and gives off light after rain. It is worth mentioning that the *Panellus stipticus* has an important role as a hemostatic agent (blood thickening agent) [1]. Next, the author has a brainstorming. The author thinks that the luminescent material can be extracted from the *Panellus stipticus*, and used it as the wick of the billboard in the hospital at night. This design method can make the hospital more emotional and play a role in popularizing science for people coming and going in the hospital. Furthermore, this form of design is more environmentally friendly.

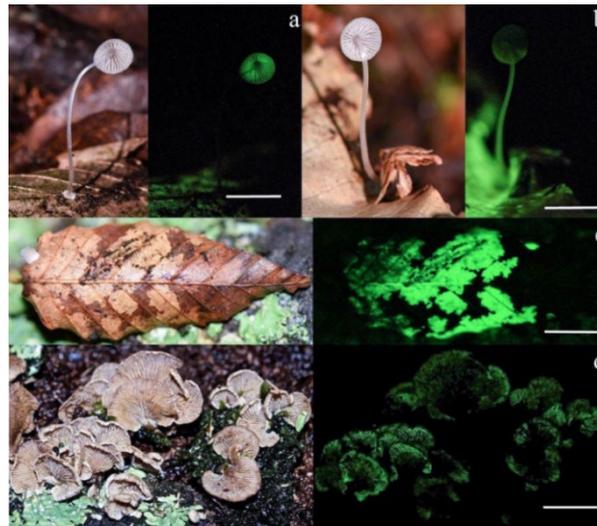


Figure 1: Bioluminescent Mexican basidiomes (paired light and dark exposures). Cortes-Perez, A., Ramirez-Guillen, F., Medel, R. and Rockefeller, A., (2017). First record of bioluminescence in fungi from Mexico. *Mycotaxon*, 132(3), pp.611-619.



Figure 2: *Panellus stipticus*. Kuo, M., (2017). *Panellus stipticus*. MushroomExpert.Com. [online] Available at: <http://www.mushroomexpert.com/panellus_stipticus.html> [Accessed 21 October 2022].

As shown in the Figure 3, the wood below can also shine in addition to the above special mushrooms. The honey fungus *Armillaria mellea* is the main cause of luminous wood in Britain and other parts of Europe. Its luminescence is surprisingly little publicised, despite its awesome horticultural reputation and widespread distribution [2]. Combined with this biological phenomenon, we imagined whether we could extract the honey fungus *Armillaria mellea* to design poster which show at night. This may have technical difficulties at the moment, but it may be a viable new light medium for design in the future.

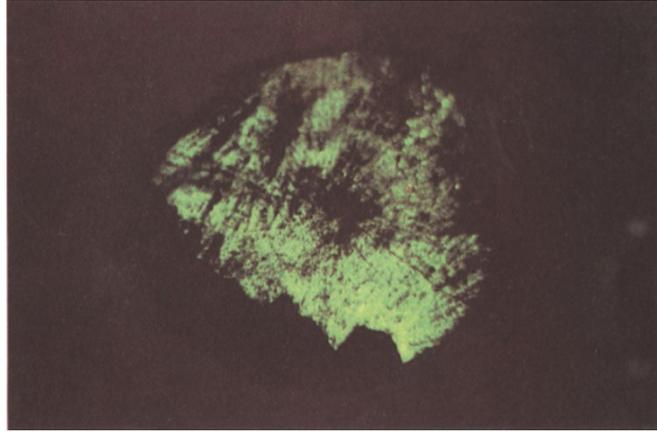


Figure 3: Luminescence of *Armillaria sp.* mycelium on the root of a rowan tree. Herring, P.J., (1994). *Luminous Fungi. Mycology*, 8(4), pp.181-183.

In addition to a lot of bioluminescent organisms on land, there are also a lot of bioluminescent organisms in the sea, as Severine Martini points out, a broad range of organisms have been described as capable of emitting light, from bacteria to jellies and fish. Bioluminescence can be either directly produced by an individual using light-emitting molecules and enzymes or by a symbiont associated with the host [3]. Besides, Bioluminescence is a major functional trait in the ocean, with three quarters of pelagic macro-organisms described as bioluminescent [4], and about a third of epibenthic organisms known to have such capability [5]. There is also a good example called Bioluminescent Bay in Dalian, China, which produces a very beautiful fluorescent sea scene every year due to the glow of plankton.

4. Case Study - Biological Lamp

Here are two good examples to help readers understand new light medium (bioluminescent medium) more deeply. Shown in Figure 4, the first example is a set of "biological lamps" designed by a Dutch company - Philips. The light it produces is using bioluminescence methods such as using fireflies and luminescent bugs. These glass containers are filled with bioluminescent bacteria, which emit green fluorescence when exposed to methane. Obviously, the green design approach makes this design work can well reflect the designer's design concept. Clive Van Helden of Philips Design said that in the face of global environmental degradation, designers have an obligation to understand the situation and find solutions based on our human needs [6]. According to this case, people can try a similar green approach to design, and make full use of the waste containers in the home for reuse, thereby promoting the development of self-sustaining light sources.



Figure 4: "Biological Lamps" designed by Philips. *Biological Lamps. Sogou Baike. [online] Available at: <<https://baike.sogou.com/v70411715.htm>> [Accessed 21 October 2022].*

The second example uses the bioluminescent creatures from the sea. The blue light of the sea in the dark is caused by light-emitting microbes in the sea. As the waves rise and fall, the microbes glow blue from exposure to oxygen. This principle inspired Dutch designer Teresa van Dongen to create a bio-lamp (Figure 5). The designers filled glass tube with microbes from octopus skin, then attached a

heavy device on one side of the tube. The tube wiggles when the user pushes the heavy device, which causes bacteria mix with oxygen and emit light. Besides, when the bacteria in the tube stop shaking, the eerie blue light disappears^[7]. According to this case, we can feel that using bioluminescent medium, the work not only achieves environmental friendliness and meets visual needs, but also meets functional needs, and the use of a bioluminescent medium can makes the work more emotional.



Figure 5: "Biological Lamp" designed by Teresa van Dongen. She let the shining sea ripple in the house. SOHU. [online] Available at: <https://www.sohu.com/a/216857954_409806> [Accessed 20 October 2022].

5. Creative Idea for Bioluminescent Medium

Everything in the world has no color, people see the color of the object is due to the reflection of light. Therefore, in this essay, the author introduces a creative idea about the chromatophores in mimic octopus (*Thaumoctopus mimicus*).

The author learned about "mimic octopus (*Thaumoctopus mimicus*)" by chance, it has a unique body structure in nature, its body is made up of thousands of chromatophores, and it is a boneless mollusk. This allows the *Thaumoctopus mimicus* to control its body to change its color and shape according to its surroundings, and it also allows the structure of its skin to closely match its surroundings to catch food. For example, the mimic octopus (*Thaumoctopus mimicus*) acts of imitation of a banded sea-snake (*Laticauda* sp.) as an antagonistic response to enemies^[8]. In addition, the cephalopods which octopuses belong are regarded as one of the world's unexploited resources with great potential. At present, many organs, skin, eye sockets and necks of octopuses are discarded in the process of octopus processing, which contains a large amount of protein and amino acids, etc., this action not only wastes resources, but also pollures the environment^[9].

Considering that military camouflage is needed to camouflage soldiers in the environment, it would be a good idea to use chromatophores of octopus in the design of military camouflage. Military camouflage is already well designed, so why consider this kind of biological redesign? This is because there are special camouflage for jungle operations and special camouflage for land operations, and the style of each camouflage is different. It will cause great trouble if the soldiers from the land to the jungle need to change clothes. To sum up, it would be much more convenient if the camouflage can change color at any time according to the environment.

The following are a series of assumptions about the new light medium (bioluminescent medium). These assumptions are only from the perspective of artistic creativity, which may lack sufficient biological knowledge base. Here only provide readers with creative ideas for reference. The *Thaumoctopus mimicus* are color-blind and cannot accurately distinguish the colors of their surroundings, but they can change their skin according to the colors of their surroundings because their skin contains special reflective proteins (reflectins)^[10].

As Albertin and her colleagues discovered, they identified a group of genes called reflectins, which are only known to exist in cephalopods ^[11]. This finding suggests that *thaumoctopus mimicus* skin is light detecting, which ultimately leads to *thaumoctopus mimicus* skin being able to see. If the reflective protein (reflectins) is extracted and applied in the design of camouflage, the camouflage can recognize colors without relying on human eyes, but the camouflage itself has the function of recognizing colors.

Once the camouflage can recognize colors, how they change color involves the "chromatophores" in the skin of *thaumoctopus mimicus*? When the *thaumoctopus mimicus* are excited, the muscles contract, which causes the pigment organs to expand, and eventually the skin can take on more pigment to reflect the colors of its surroundings. In contrast, when their muscles relax, their skin show less colors because their pigment organs shrink ^[12]. If we think about camouflage design, do we need the fabric similar to the muscles of *thaumoctopus mimicus* that can contract and relax? The answer is of course not. If the fabric was designed similar to the muscles that can contract and relax, it would pose a risk to soldiers' safety. After these analyses, it can be considered to directly extract reflective proteins (reflectins) and use it to identify the color of the surrounding environment in the fabric design, and then use enough chromatophores in the fabric to change the colors of clothing. After the colors are recognized by the reflectins, the color information will be transmitted to the chromatophores for color-changing. How reflectins transmits information of color to the chromatophores may be found in the relevant papers of Dr. Xu for reference ^[13].

Through the above thinking and conjecture, a problem emerged. If the clothing are combined with "reflective proteins (reflectins)" and "chromatophores", a series of cleaning and storage tasks for clothing may be costly. If cleaning and storage technology is not provided, the camouflage will become disposable, which is a waste of resources and a threat to the ecology. Therefore, the authors guessed whether the chromatophores discussed above could be processed into a biological spray together with the reflectins and some substances that can maintain its activity. Soldiers can spray on the clothing to form a film and change the color of the clothing if the spray could be used instead of the clothing fabric. This way, the biological fluids can be stored in the bottle to avoid the difficulty of storing and cleaning. Besides, it could be sprayed not only on clothing to discolor the clothing, but also on weapons to discolor the weapon if produced as a spray, which would better ensure that the soldier could be camouflaged in the environment. The above is the author's idea about the design of new light medium (bioluminescent medium). It may not be practical, so it only provides readers with some design inspiration.

6. Conclusion

As one of the elements of the design work, medium participate in the composition of the work. Therefore, in the process of creating design works, medium is indispensable. In a work, the author's values can be expressed through the choice of medium, and the value of the work can be increased by choosing the good medium, so as to promote the work to leave a good impression in the hearts of the audience and arouse the resonance with the audience. Finally, a series of economic and environmental benefits can be triggered if the design works can be successfully recognized by the audience.

On the other hand, the current environmental problems are not optimistic, and the green design is gradually rising. When the design works combined with the new light medium (bioluminescence medium), the goal of green design can be promoted and the desired visual effects can be achieved. In addition, the use of bioluminescence medium can also give design works a powerful functionality.

At present, the new light medium (bioluminescence medium) mentioned in this essay may be difficult to be widely used due to technical reasons, but the use of this bioluminescence medium may become a good way of creation in the future. At last, it is expected that designers can take inspiration from this essay and try out these new medium.

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