The added values of employing the advanced smart materials in the design of the metal furnishing systems for the exhibitions

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Abstract:

The designer of display systems in general and metal systems in particular is interested in harmonizing the various design inputs and outputs, so that the design system is integrated in its functional performance as well as in its characteristics and fulfills desires of users. The designer is also keen to achieve the best functional efficiency of the metal display system in order to be able to compete with similar systems in the quality and efficiency of performance, achieving this functional requirement, which is one of the most important requirements of the user that determines the extent to which the metal display system meets his desires and his desired needs. Also, making use of smart new materials technologies contributes to raising the efficiency of design and production of metal furnishing systems for exhibitions and providing many design solutions that can meet the needs of the Egyptian society. Therefore, the research aims to study the smart new materials and how to use them in metal furniture design systems for exhibitions and monitoring the functional, use, engineering, communication, economic, aesthetic and environmental values added to employ the smart materials developed for these systems. The research problem can be identified in that the smart developed materials are considered one of the most important inputs to the design process in many fields, but in return they do not receive sufficient attention at the local level, especially in the field of exhibitions as it relies on traditional materials such as iron, aluminum, wood and marble, which can be replaced by novel materials that add functional, structural, aesthetic and economic values, as well as the limitations of the metal furnishing systems for exhibitions in the Egyptian market that depend on traditional materials in achieving added values for design at the functional, use, engineering and communication levels as well as the economic, the Aesthetic and environmental aspects, which created the need to monitor these added values for employing smart materials developed in the design of metal furnishing systems for exhibitions, and the research concluded that each type of developed smart materials has its own characteristics and distinctive characteristics that distinguish it from other developed smart materials that have a role in the design of the metal display system. The new smart materials have the ability to cope with the environment surrounding the metallic display system and have a distinctive reaction to the surrounding stimuli.

Key words:

smart materials - metal furnishing - metal display systems

Introduction:

With the technological interest in making use of the new materials and using them greatly in many fields, they have structural, functional, environmental and economic advantages. Where raw materials play an important role in the design process as a tool for embodying ideas and application and finding many design solutions that achieve functional, aesthetic, economic and

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environmental values of the product, where the process of choosing materials depends on the designer's perception of the properties of those materials in terms of physicality and construction. The increasing progress in raw materials technology has contributed to the emergence of new concepts such as smart materials, composite materials and nanomaterials that can be used in the design of metal furnishing systems.

The designer of display systems in general and metal systems in particular is interested in harmonizing the various design inputs and outputs, so that the design system is integrated in its functional performance as well as in its characteristics and fulfills the desires of the users. The designer is also keen to achieve the best functional efficiency of the metal display system in order to be able to compete with similar systems in the quality and efficiency of performance, achieving this functional requirement, which is one of the most important requirements of the user that determines the extent to which the metal display system meets his desires and needs.

When functional, usability, and economic values are achieved and are integrated with all engineering considerations, the metal display system is geometrically balanced and suited to its designed function in order to achieve it, thus facilitating its use and operation without any impact on the safety of the user.

Research problem:

The research problem can be identified within the following points:

- The advanced smart materials are considered one of the most important inputs to the design process in many fields, but on the other hand they do not receive enough attention at the local level, especially in the field of exhibitions as they depend on traditional materials such as iron, aluminum, wood and marble, which can be replaced by new materials that add functional, economical, construction and aesthetic values.
- The deficiency of the metal furnishing systems for exhibitions in the Egyptian market that depend on traditional materials in achieving added values for the design at the functional, use, engineering, communication, economic, aesthetic and environmental levels, which created the need to monitor these added values to employ the advanced smart materials in the design of the metal furnishing systems for exhibitions.

Research objectives:

The research aims to study the advanced smart materials and how to benefit from them in designing metal furnishing systems for exhibitions and monitoring the functional, use, engineering, communication, economic, aesthetic and environmental values added to employ the advanced smart materials for these systems.

Research Methodology:

The research methodology is based on the descriptive approach of studies related to advanced smart materials and the design of metal furnishing systems for exhibitions.

Research hypothesis:

The researcher assumes that making use of advanced smart materials technologies contributes to raising the efficiency of design and production of metal furnishing systems for exhibitions and providing many design solutions that can fulfill the functional, aesthetic and environmental

needs of the Egyptian society as well as preserving the symbolic value within an economic framework.

First - The concept and types of smart materials developed for the metal display system.

The advanced smart materials are considered one of the results of the use of new technological techniques, as their use contributes to the development of functionality and improves the aesthetics of the metal display system. In the past, traditional materials such as metallic and non-metallic materials contributed to the design and manufacture of various metal display systems.

The advanced smart materials are materials with special properties that distinguish them from traditional materials, and these properties are (Transitional, Selectivity, Immediacy, Self-Automation, and Direct).

As for transitional: it is the ability of the created smart material to respond to external stimuli exposed to it, which appears in more than one different environmental condition.

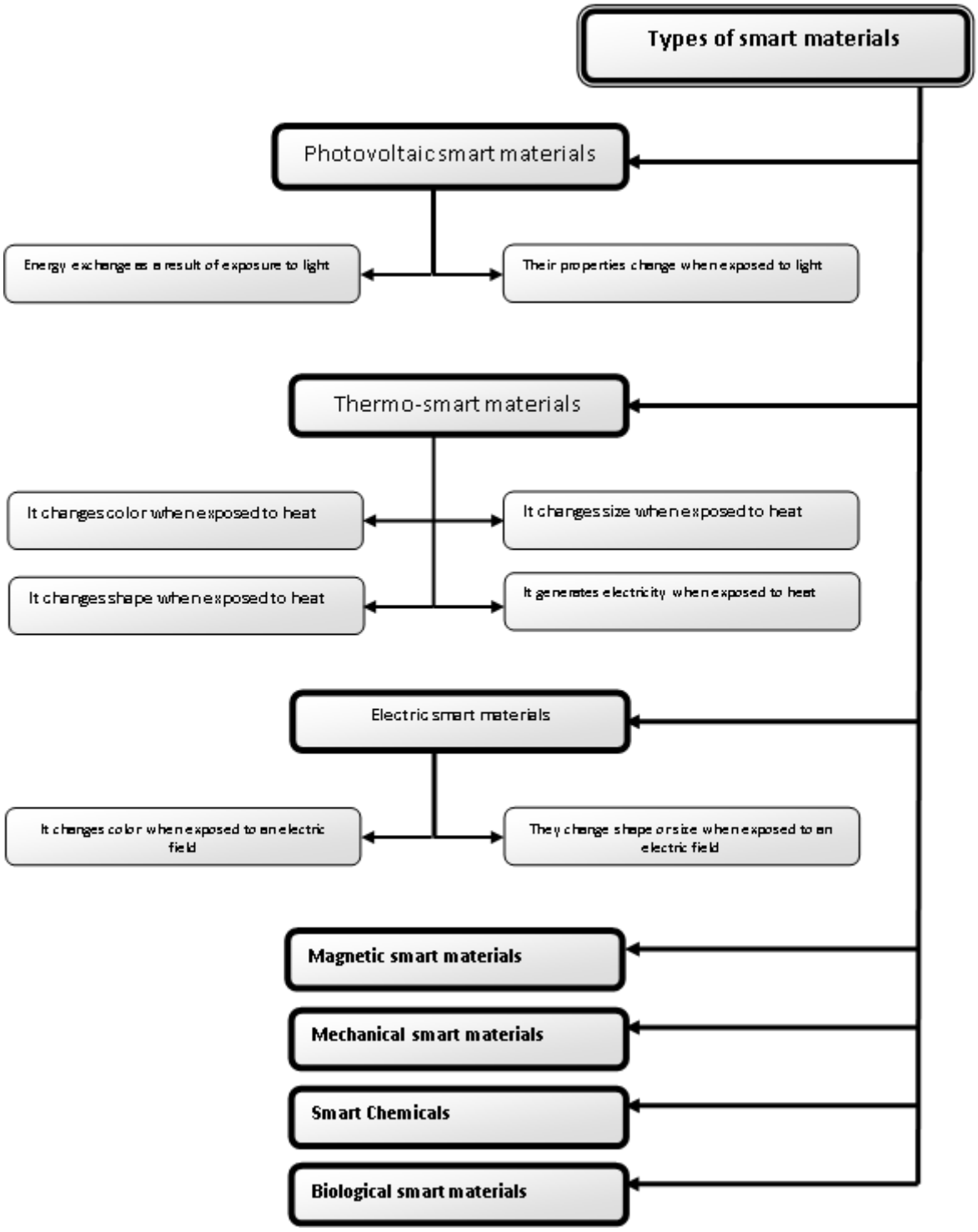
Whereas selectivity: is the distinct reaction of the newly developed smart matter, which enables it to predict the surrounding environmental stimuli.

Immediacy: Immediacy is the term for real-time response.

Self-Automation: It is the ability of the created smart material to respond to external stimuli surrounding the material based on the atomic structure of the created smart material instead of the external structure through energy absorption and recovery.

Direct is the immediate response when an affected impact occurs.

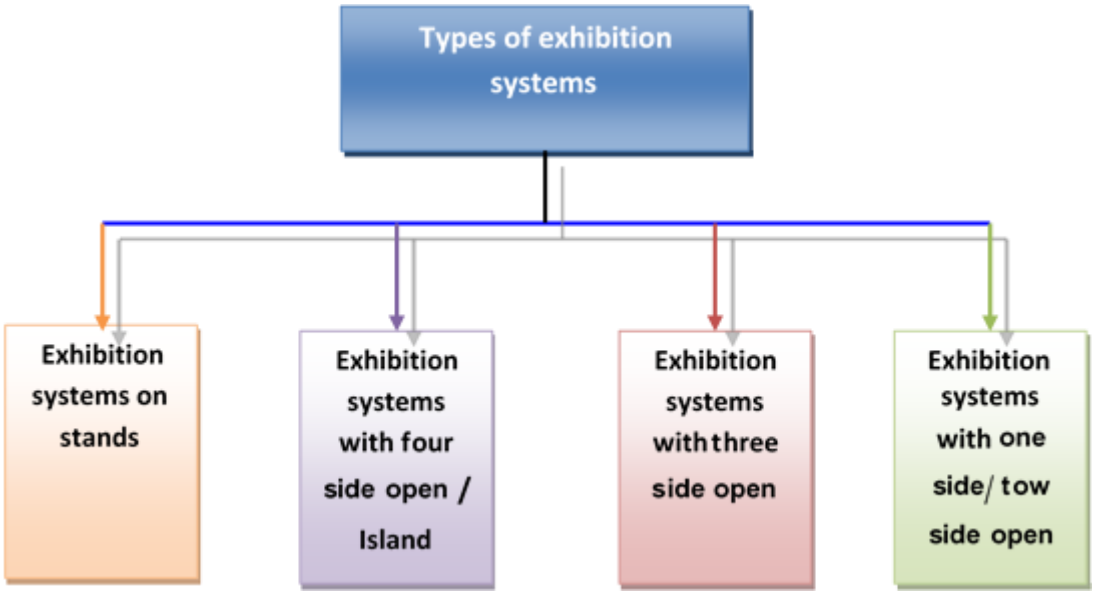
Smart products depend mainly in their structure on smart materials that are included in their main configuration, through which the smart product acquires its characteristics, smart products is a term given to products that respond intelligently to the surrounding variables through the physical dimension and Information-based dimension, so that it changes its state according to the physical and environmental variables by causing interaction and resetting its state according to these physical and environmental conditions.



Second - exhibition systems (concept, types, advantages and limitations)

There are many types of exhibition systems in terms of the form they are created on, which determine the nature of the presentation and how to communicate with the target audience, which also largely determine the method of presentation, its tools, and its visual connection with the audience.

Exhibition systems can be divided into four main types, which can be illustrated in the following figure:



There are many limitations of designing exhibition systems, which can be clarified in the following points:

1- Determine the purpose of holding the exhibition and implement it through the exhibition pavilion, whether the purpose is "commercial - tourism - advertising ... etc.".

2- Determining the type of visitors of the exhibition, "Defining the target audience (in terms of age group - social level - cultural level - profession ... etc.)."

3- The simplicity and clarity of the design idea in designing exhibition systems.

4- The use of various complementary design methods that are understandable, short, accessible and clear for the recipient.

5- Choosing the right place to set up exhibition systems in terms of (ventilation - lighting - location - space - visibility - smooth accessibility).

6- Organizing the exhibits in a simple way, taking into account the appropriate distance between the exhibits and between the visitor and the visitor's line of movement.

7- Paying attention to the general shape design, taking into account the consistency of colors, sizes and textures.

Third - the added values of the metal display system as a result of employing the advanced smart materials:

The employment of advanced smart materials in the metal display system achieves a set of added values for the metal display system, which makes the metal display system more modern and distinctive and competes with the similar traditional metal display systems, and this is considered an added economic value.

The following is the set of added values as a result of employing the advanced smart materials:

(1) Functional values:

The employment of smart materials in the various metal display system added to it a new functional value, which is called the secondary functional value, in addition to its emphasis on the basic functional value.

(2) Usage values:

It is known that the suitability of the metal display system for use during operation in terms of weight, as well as the safety limits and the ease of operation and dismantling and installing its units together are among the usability considerations that need to be met by the metal display system.

(3) Geometric values:

The ability of the metal display system to achieve the engineering considerations represented in achieving balance, discharging forces and stresses, achieving electrical and mechanical safety factors, and ease of maintenance ... etc., are among the factors that add a competitive engineering dimension to the metal display system from the similar metal display system.

(4) Aesthetic values:

The metal display systems using smart materials have given them a much higher aesthetic value than the metal display systems that are made of traditional materials. In addition to its flexibility, high durability, self-operation, directness and selectivity, which are characteristic of metal display systems made of smart materials.

(5) Communication values:

The use of smart materials in the design of the metallic display system has achieved the value of an informational communication added to the metal display system that was not previously present by using traditional materials, which makes the metal display system more distinctive and interactive with the user and creates a group of feelings and emotions capable of attracting the user.

(6) Economic values:

By employing smart materials with the used traditional materials, despite the high cost of obtaining them, it helps to increase their life span and operational efficiency and reduce the cost of maintenance, which gives it an added economic value for the metal display system that was previously present using traditional materials.

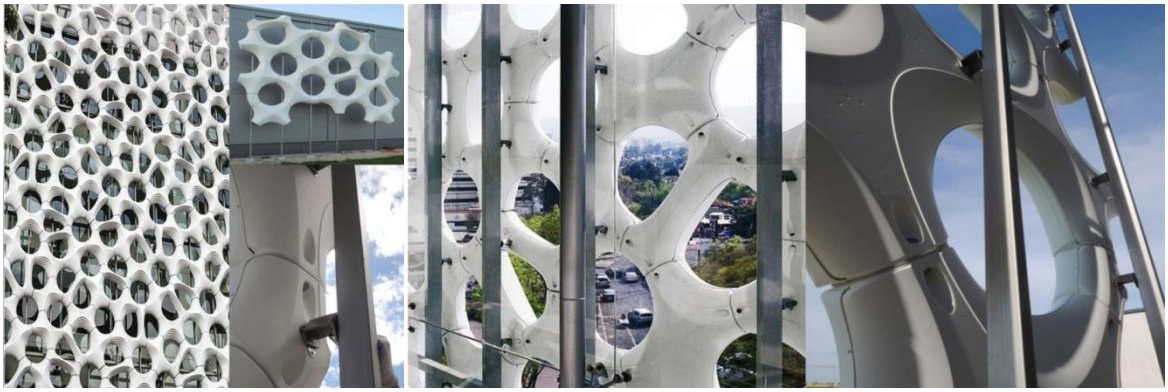
(7) Environmental values:

By integrating smart materials with traditional materials when manufacturing the metal display system, environmental advantages have been added to them, as the added smart materials are non-toxic materials that do not interact with the environment and thus do not pollute it, but can decompose into primary organic elements in the environment.

Examples of added values as a result of employing the new smart materials:

1- Air-purifying Nano-titanium Dioxide

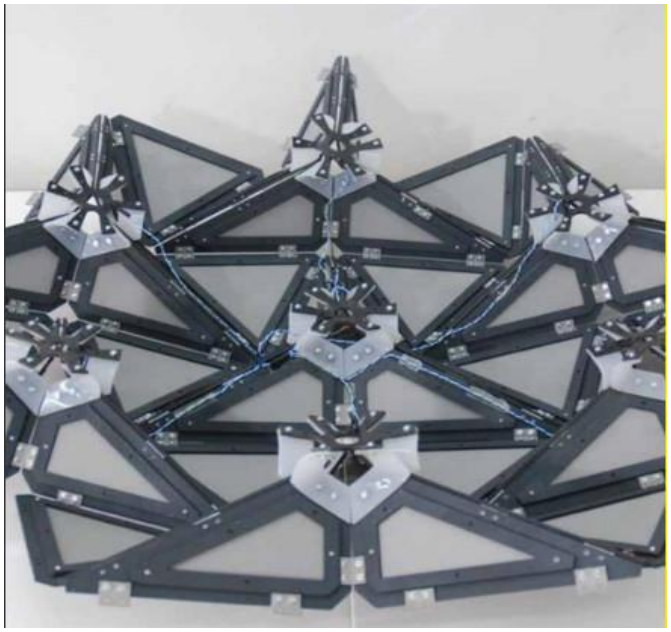
The smart substance "titanium dioxide" that converts harmful environmental pollutants into harmless chemicals. The structure of the metallic system consists of titanium dioxide, whose designers assert that it produces water and carbon dioxide from the smog in the atmosphere, which makes it suitable for metal display systems for open or closed exhibitions.



By integrating the new smart material titanium dioxide with traditional materials when manufacturing the metal display system, it has been possible to add environmental advantages (reducing environmental pollution and environmental sustainability), economic advantages (longevity and sustainability of the smart material), and aesthetic advantages (the shape does not change due to the influence of environmental factors over time), and functional advantages (performing the primary function of the display system along with realizing added environmental functions).

2- Shape-memory polymers - SMP

Shape memory polymers are an emerging class of smart-active polymers with the ability to double-shape. It can change shape in a predetermined way from shape A to shape B when exposed to an appropriate environmental stimulus, which makes it suitable for open or closed exhibition metal display systems.



By integrating SMP with traditional materials when manufacturing the metal display system, it has been possible to add environmental advantages (smart interaction with changing the air temperature), economic advantages (longevity and sustainability of the smart material), aesthetic advantages (the shape changes in response to environmental factors, which allows

flexibility of formation with aesthetics), and structural functional advantages (flexibility of the form, change of the display system, besides achieving its main structural functions).

Results

1- Each type of smart material has its own distinct characteristics that distinguish it from other smart materials that have a role in the design of the metal display systems.
2- Smart materials have the ability to adapt to the environment surrounding the metal display system and have a distinct reaction to the surrounding stimuli.
3- Smart materials can predict their reactions, and their different reactions can be controlled according to the change of the type of catalyst and can play an effective role in the design of the metal display systems.
4- Replacing the traditional material with the smart material and employing it in the metal display system enables the designer to develop functional performance and aesthetics.
5- Smart materials can add functional, use, communication, aesthetic, economic and environmental values to the metal display system, making the metal display system more modern and distinctive and competing with the similar traditional metal display systems.
6- Characteristics of smart materials increase the creative capabilities of the designer in order to achieve competitive values when designing and producing metal display systems in comparison with similar systems in the market.

References:

1. Adawiyah J. Haider, Zainab N. Jameel, Imad H. M. Al-Hussaini (2019) Review on: Titanium Dioxide Applications, Energy Procedia 157,17–29
2. Addington, Michelle and Daniel Schodek (2005) Smart materials and technologies for the architecture and design professions. Burlington: Architectural Press
3. Arjomandi, Maziar (2007) Smart Material in Aerospace Industry. The University of Adelaide. school of mechanical engineering.
4. D'Alessandro, A.; Pisello, A.; Fabiani, C.; Ubertini, F.; Cabeza, L.; Cotana, F. (2018) Multifunctional smart concretes with novel phase change materials: Mechanical and thermo-energy investigation. Appl. Energy,212, 1448–1461.
5. Schwartz, M. (2009) Smart Materials; Taylor and Francis: Abingdon, OX, USA.
6. Stephen Bitgood (1994) Designing Effective Exhibits: Criteria for Success, Exhibit Design Approaches, and Research Strategies - VISITOR BEHAVIOR ,Winter, Volume IX Number 4
7. Wei Zhao, Liwu Liu, Fenghua Zhang, Jinsong Leng, Yanju Liu (2019) Shape memory polymers and their composites in biomedical applications, Materials Science & Engineering C 97 (2019) 864–883