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# Smart Technology and Materials in the Clothing Industry

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#### Abstract

s technology grows more and more ingrained in our daily lives, high-tech fabrics play everlarger roles. Materials that perceive and respond to stimuli or environmental circumstances are known as smart textiles. Phase-change materials for thermoregulation, chromatic materials that alter color in reaction to environmental changes, and shape-memory polymers that alter form in response to temperature variations are a few examples. Interfaces, microprocessors, inputs (sensors), outputs (actuators), software, energy (batteries and solar panels), and materials (electronic textiles and improved materials) are the primary technological components utilized in the production of stylish wearables. Additionally, 3D printing has becoming increasingly important in the fashion industry, and designers are becoming much more aware of and interested in this technology.

Keywords: Smart Technology, Smart Materials, Clothing Industry

## **Introduction**

the goal of creating modern textile fibers and materials with high-quality aesthetic and functional properties and performance that are used in the rapidly developing fashion industry using the era's innovations of modern technical methods, advanced technology, scientific techniques, and new materials, technological progress has become a subject of study and interest in laboratories and scientific laboratories. Therefore, the field of designing Due to ongoing invention and renewal in keeping with the prevailing language, the fashion industry is one that is changing quickly. Smart technologies were able to infiltrate the fields of contemporary technology and fashion design by posing numerous practical and aesthetically pleasing difficulties to designers of international fashion shows. [1-14]

Fashion designers face numerous hurdles as a result of smart technologies' significant entry into the industry.

International fashion shows can employ it both visually and effectively, which is why this field has seen numerous scientific applications. the development of artistry that was previously challenging as well as the discovery of numerous ways to improve both the utilitarian and aesthetic qualities.

Smart fashion is a trend that is visible in clothing, accessories, materials, and color manipulation to highlight movement's dynamism, as well as hue. The Futuristic School has undoubtedly succeeded in establishing this style by fusing technology and fashion through the use of unusual materials and methods[4, 7, 14-23]

## Fashion Design

It is all the artistic inputs, such as lines, space, colours, materials and complements, with coordination and rules of balance and rhythm.

Including the pain of arriving at an application design that is ready for use.

- Repetition, ratio, proportionality, and formulation scientifically and technologically
- Fashion is one of the fields of arts related to the changes of the era, whether intellectual, philosophical, or technical.

It is in its meaning

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- A wide range that accommodates those variables not only at the local levels of different and distant environments, but also at the local level.
- The world, and fashion is a global language that is easy to spread and circulate among the countries of the world. The guests were of different colors.[24]

## **Fashion Trends for Smart Fashion Design**

- The design source is the resource from which the artist draws inspiration for his ideas. The sources of design have been numerous throughout the ages, and they were letters and flowers at Dior Christian houses, and ballet dancers' gowns at Pierre Cardin and art schools Like Mondrian's painting by Yves Saint Laurent. The creative fashion designer develops with the changes taking place around him.
- He does not take a passive stance towards this, as he looks with the eyes of the researcher.[25]
- The serious, contemplative and meticulous person who engages in the experience of research and engagement with scientific and technological progress to discover through it what suits him.
- To confirm what is being expressed. There are many fashion designers who were influenced by future artistic trends and technological development.

#### **Classification of Smart Fashion**

There are many ways to classify smart clothes based on their multiple fields and use in different areas of life, as well as depending on the viewpoints of specialists, thinkers, and designers interested in it, and the future holds expectations for the development of smart clothing, which

Creating real challenges to apply scientific theories to a real scientific reality

Smart fashion can be characterized by many special technologies, such as:

- Smart color control techniques used in fashion design.
- The application of smart textiles for temperature control.
- Memory tissue textiles.
- Water-resistant and breath-resistant fabrics.
- The intelligent fabric of electronic information Smart sports fashion.

#### Smart color control techniques used in fashion design

## Chromium raw materials

These are the materials that radiate color, fade or change color when external influences occur on them. These materials are classified Depending on the type of stimuli that affect it. Therefore, they are known as color change materials. Color-changing materials are divided into two types:

#### A- thermo chromic materials

They are heat-sensitive materials made of different compounds that need to be dissolved in inks appropriate for the application being used. And change

Chronothermal materials change color when there are changes in the temperature of the surrounding medium, and this effect is reversible.

The change in color occurs depending on the temperature, which can change the structural composition of the material.

There is a reflection mechanism Color at different temperatures, as when exposed to heat, the layer of liquid crystals is compressed, which affects the color.

When the reflected light is cooled, its area increases, as Figure 4 shows (and thus the color changes, as the color of the reflected light

It depends on how close the layers of liquid crystals are together.

# Chromium materials can be divided into three types, which are:

- A type affected by low or cold temperatures.
- A type affected by body temperature, including (touch breathing),
- A type affected by high temperatures As in complaint

## B. Photocromic materials:

Photochromic materials used in fashion change colors when there is a change in light intensity, which is a reversible effect.

This substance is usually colorless in dark places, and when exposed to sunlight or ultraviolet rays, it changes.

The molecular structure of the substance and the color appears, and when the effective light source is removed, the co lor disappears

These pigments are available in the form of crystals powdered of light-sensitive pigments that are dissolved To obtain liquid inks for use in applications. Once these dyes are exposed to sunlight or ultraviolet rays

Violet, it changes from the transparent state to the colored state, and when the source is removed, it returns to its original state.

#### Fluorescent Materials

Fluorescent substances produce visible light Or hidden as a result of exposure to light falling on it, and the effect stops when the lighting source disappears. Fluorescent substances produce visible light. The radioactive pigments produced from these materials are weak in color or white in sunlight, while when Exciting it with ultraviolet rays illuminates a concentrated radiant color in the dark.in most cases it is for light

The emitted radiation has a longer wavelength and therefore less energy than the absorbed radiation.[25-27]

#### Smart textiles for temperature control

- Textiles can be divided into three categories: insulation textiles for heat, refrigeration fabrics, and automatically controlled fabrics for temperature according to their stimulus response to external temperature.
- Temperature insulations use thermal storage fibres for sunlight or remote infrared fibres to achieve thermal insulation. Solar thermal storage fibres radiate visible light and infrared radiation near the sun ' s rays absorbed into the human body in the form of heat to achieve the effect of maintaining heat; remote infrared fibres transform the heat from the human body into a certain wavelength range of remote infrared. The radiation restores the human body to reduce the loss of heat by accelerating the circulation and achieving the effect of maintaining heat. So, the performance of maintaining heat for remote infrared fibres is better.
- Refrigeration fabrics mainly include protection fabrics from ultraviolet radiation and heat, cold fabrics, and fabrics that disperse the heat. Ultraviolet and heat protection fabrics are mixed together with soft ceramic powder, which can reflect UV radiation in polymer solution and then weld in fibres. His absorption rate for visible light and nearby infrared is low, making the human body cold. The temperature in this tissue is 2,4 less than the traditional cotton fabric: the cold tissue adds metal oxide to polyester fibres, through metal oxides to weaken the wear fade from UV and light, making the inner part of the clothing colder, and can reduce 5°C; the heated tissue is mixed with metal powder paint in the fibers, so that the heat from the human body can quickly be wasted to the outside world through metal powder with high thermal conductivity such as Fe, Cu, Al, Zn.[28, 29]

Automatic temperature-regulating textiles can control temperature in both directions. In general, it's a combination of stage-change technology and fibre-manufacturing technology. It can absorb and release thermal energy according to the temperature rise and decrease surroundings. [4, 7, 14, 17, 19-23, 30-35]

## Memory tissue textiles

Form memory tissue refers to textiles that can change the shape, size or internal structure of the tissue after exposure to external catalysts (e.g. temperature, humidity, light, magnetic field, pH value), but can return to its original state under specific circumstances. Including textiles made from memory-shaped alloys, textiles made from memory polymer tissue and the formation of memory hydrogen textiles.

Textiles made from the memory of the form alloys refer to metal alloys in fabrics that can be converted between a variety of different crystal structures after thermal stimulation, which can cause tissue changes, such as gold, cadmium, nickel, titanium, copper, aluminum-nickel, aluminium and zinc. ; Form memory polymer fabric is polymers formed by implanting a moving matrix through permanent physical or chemical interlocking methods; the matrix can store mechanical deformation energy; the deformity can be restored after the tissue is stimulated from outside; and the hydrogel tissue of the memory of the form achieves the memory of the form through hydrolysis, which can swell in water but is not soluble in water.[28, 29]

## Water-resistant and breath-resistant fabrics

- Respirable fabrics are also called "breathable fabrics," which means that the cloth is not wet by water under a particular water pressure, which makes it a runaway. At the same time, the race from the human body can move to tissue in the form of water vapor. On the outside, it's uncomfortable not to accumulate density between the surface of the human body and the tissue. Basically includes 4 types of high-density water-resistant and humidity-resistant fabrics, small-poison membranes, non-poisonous membranes, and intelligent species. [36-43]
- High-density water-resistant and moistureresistant tissue uses the principle of the proliferation of gas molecules from high to low concentration. When the human body is sweaty, the sweat can spread out through the cloth, and when the cloth is wet, the fibers can swell sideways and the gaps become smaller to achieve a water-resistant effect; a waterresistant water-resistant and moistureresistant small membrane that achieves water and moisture permeability through the difference in size between the drop of rain and the molecular diameter of water vapor; an unsound water-resistant and moisture-resistant membrane that improves the membrane surface through water-friendly properties to achieve water-resistant effect; and waterresistant and moisture-resistant smart tissue that means that the fabric can automatically adjust the permeability of moisture according to different environmental characteristics. For example, the fabric has a high humidity

efficiency at high temperature to achieve an excellent effect on the wear and sweat, while the fabric at low hypothermia can reduce the wear of the heat and improve heating.[16, 44]

## The intelligent fabric of electronic information

- It is a combination of fine, flexible electronic components and textiles, so that the sensor can understand changes the in external process environment, information. issue judgments and instructions, and then change the initial condition of the material through the driver to adapt to the outside world changes in the environment, to achieve self-diagnosis, self-regulation, self-repair and other functions. The main techniques adopted according to the different methods of combining microelectronic components with textiles are standard technology, integrated technology and fibre-based technology.
- technology Standard directly integrates electronic components as function units on textiles, such as adding different sensors directly to the fabric to monitor human body temperature, heart rhythm and other data; integrated technology is the direct integration of electronic components into fabrics, such as the delivery of circuit boards through connective threads, flexible fabric-based sensors, integrated circuits, etc.; fibre- or fabric-based technology is used to form electronic components and sensors directly, such as flexible fabric display screens, pressure-sensitive flexible materials, etc.[16, 44]

# Practical applications

## Smart color-changing textiles

- Smart, color-changing textiles refer to fabrics that change color with changes in external catalysts (e.g. light, electricity, pressure, temperature, etc.). This type of smart textiles mainly includes color textiles, thermal fabrics, electrocromic textiles, pesocromic textiles, and chrome wet fabrics.
- Photocromatic textiles is the effect of color change on the transformation of A to isomer B under the influence of different light waves.
- Remove the source of light or change to another source of light, convert B to A, and return the color to the original color; thermal fabrics are due to the fact that the molecular composition of dyes on the fabric can change with temperature, causing changes in color; electrocromatic textiles refer to the visual properties of materials (reverse rate, absorption, light efficiency, etc.) that produce constant and reversible changes under the

influence of an external electrical domain; changing fabrics sense pressure-sensitive color changes the compressed part of the cloth through a matrix formed through the interlocking of connected fibres.[45, 46]

color-changing textiles have better Smart, wearability and can be used in civilian, military and high-risk industries. In the military field, it can be used for military camouflage, such as variable colour camouflage clothing that can be controlled; in the medical field, it can be used for medical surveillance, such as children's clothing, to monitor whether the child suffers from fever through a change in the color of clothing; special protection for occupational safety, such as longterm exposure to chemicals in a dangerous environment or strong radiation, will change the colour of clothing; it can be understood as digital, such as electrical clothing, TV job on clothing; fashion field, such as photocromatic parachutes, photocromatic shirts, etc. The t-shirt shows photocromick.[47]



Figure 1

#### The application of smart textiles for temperature control:

Smart textiles can be used to control the temperature of civilian clothing, such as refrigeration jackets, sports clothing, ski allowances, etc., as illustrated in figure 2; occupational clothing, such as space suits, fire allowances, diving allowances, etc.; for medical purposes, bandages can be made at a constant temperature to protect wounds. To prevent local temperature from rising too high or too low; in the automobile industry, it can be used for seats and ceilings inside cars.[48, 49]



Figure 2

Memory tissue textiles

Textiles with formal memory are mainly used in nonferrous, shock-resistant and other functional areas and aesthetic areas, such as burn-proof clothing. When clothing is exposed to high temperatures, fibres change from a flat surface to a pagoda shape to achieve the effect of protecting the human body; textiles use hydrolytes mostly in the uniform of marine workers; check figure 3 for memory clothing; and form memory fibres are often also used in cushions and mattresses.[16, 29, 50]



Figure 3

#### Water-resistant and breath-resistant fabrics:

Water-resistant fabrics and moisture can be used for military clothing, such as pilot uniforms, marine allowances, etc.; special work uniforms, such as fire-fighting uniforms, police uniforms, surgical uniforms, polar protective clothing, etc.; can also be used for skiing allowances, mountain climbing allowances, sports clothing, etc. Sports boots, tents, etc.; Diary and Azekora fabrics developed by Mitsubishi in Japan can be used as sports clothing, baby diapers, etc., which can control moisture permeability through body temperature. See figure 4 for water-resistant and breathable tissue.[50]



Figure 4

#### The intelligent fabric of electronic information

- Smart textiles for electronic information will be widely used and are one of the most promising smart textiles. It can be used in medical and health aspects, such as medical shirts, as shown in figure 5.
- He can monitor the temperature of his body, heart rate, blood pressure and other data to achieve remote surveillance of patients in the hospital.

- When an emergency occurs, the hospital can find it through the GPS on the shirt. For emergency patients, there are smart socks, smart kid clothes and other similar smart clothes used for medical purposes; for sports and fitness, it is appropriate for users to check practice time, stress, distance, energy consumption and other practice standards, such as heart rate, bra smart gym clothes, etc.; they are used in digital multimedia products, such as the musical jacket.
- She can't just play the music already stored by the user, but also listen to radio shows. The function of operating music is provided through full control of the textile keyboard; the main source of energy is solar energy, wind energy, etc.; for military purposes, such as combat uniforms with ultra-microsensors, which can identify wounded and bleeding parts of soldiers.
- The uniform could expand this part and shrink immediately to stop the bleeding. There are also smart umbrellas that can detect weather and ground conditions and change direction of flight and speed in time.[50]



Figure 5

## <u>Summary</u>

At the end of the research, the use of the smartcolored technology in fashion design, the colors of which change depending on the type of catalysts that affect them, was shown. The study deals with the use of three different techniques: chromothermal dyes, chromium dyes and bright colors in the dark. The study reviewed the application of these materials to clothing using chromothermal dyes that change color according to temperature, the use of the embroidery thread painted with chromosomal dye, the color of the thread changes when exposed to sunlight, and, finally, the use of fluorescent substances - which light themselves in the darkness after being exposed for a period of time in the lighting of the darkness. They also include substances that change as a result of a change in temperature and substances that have a resemblance to their original form after removing the effect when the

clothing is exposed to high temperatures, fibres change from a flat surface to a pagoda shape to achieve the effect of protecting the human body and categorizing water-resistant fabrics and breathing.

Water insulation, which is also called "breathable fabrics," means that the cloth is not wet by water under a particular water pressure, which makes it a runner for water. Classification of electronic information for smart textiles

The intelligent fabric of electronic information is a combination of fine, flexible electronic components and textiles, so that the sensor can understand changes in the external environment, process information processing, issue judgments and instructions, and then change the initial condition of the material through the driver to adapt to the outside world changes in the environment, to achieve self-diagnosis, self-regulation, self-repair and other functions. The main techniques adopted according to the different methods of combining microelectronic components with textiles are standard technology, integrated technology and fibre-based technology. [15, 16, 24-29, 44-50]

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## **Conflict of Interest**

There is no conflict of interest in the publication of this article.

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