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The Impact of Technology on Jewellery Design and Manufacturing: Exploring Traditional and Modern Techniques

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Abstract

Gemstones and jewelry have been a part of mankind since ancient times, with early jewelry made from pebbles, feathers, bones, and shells. Gems were prized for their durability and beauty. Diamonds became more common after the discovery of cutting techniques in Europe around 1300. Jewelry served various purposes, including as amulets for protection and symbols of power. Different civilizations, such as the Egyptians, Greeks, Romans, and Byzantines, had their own unique jewelry styles and techniques. The Middle Ages saw a decline in luxury jewelry, but the Crusades brought new influences from the East. Jewelry-making techniques have evolved over time, with modern methods such as 3D printing and CAD/CAM being used today. The jewelry-making process involves designing, CAD/CAM, model making, rubber molding, waxing, casting, grinding, filing, metal setting, and polishing.

Keywords: Technology, jewelry, smart materials, metal, jewellery making process

History of jewelry technique

Gemstones and jewelry have been a part of mankind since before history was written. It started when man set foot on Earth and time began. Naturally, the jewelry worn by the ancients was not created in the same way as it is today. The jewelry worn by the ancient people was fashioned from colored pebbles, feathers, bones, and shells. These multicolored stones were gems, and gems have long been prized for their durability and beauty when used to create jewelry. Before people discovered how to cut diamonds to display their brilliance, which happened in Europe somewhere around 1300, diamonds were not very common. Numerous jewelry designs that are still produced today started out as useful items. Closure clasps were the original source of pins and brooches. Early seals and indicators of identity, status, and authority were made on rings and pendants. [1]

Jewelry was first discovered approximately 25,000 years ago. This straightforward fishbone necklace was discovered in a Monaco cave. What was the meaning of this necklace? Was it for a witch doctor or the village chief? Perhaps it was a trophy a princess received from her husband for having a boy child. Even though we may never discover the true motivation behind the gift's creation, we can try to imagine what people were thinking back then.

As essential as the needs we meet when taking care of our bodies can be the need to feel accepted and like we belong. A feeling of self-worth and identity are essential, so being a part of something reflects a need as well. Teeth, claws, horns, and bones were among the first decorations that came from the hunt. Hunters believed that displaying their trophies would bring luck and good fortune on their next hunt. Recall that a good hunter was the village's daily breadwinner and that person deserved respect and benefits. Naturally, the most skilled hunters aspired to demonstrate their bravery and strength.

Jewelry was worn as amulets in prehistoric societies as a safeguard against illness and bad luck. In the legends of his journey through Middle Earth, Frodo was shielded from harm by the silver vest worn by the princess of the elves. We still hear

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stories today about people from long ago who, in some way, used jewelry and gemstones to bring them luck and fortune. These legends gave rise to jewelry designed to resemble symbols believed to grant the wearer control over love, money, and fertility. People wore jewelry because of its magical qualities.

Subsequently, jewelry came to stand for human connection and commitment. In order to identify their owners, slaves had to wear bracelets. Wedding rings serve as a symbol of a couple's commitment to one another. In the past, only powerful and wealthy European church officials were allowed to wear gemstones. This was an indication of power and wealth. In an attempt to imitate them, the commoners would accessorise their festive costumes with less costly jewelry to add color and flare. Even now, some African tribes continue to wear massive lip plugs that swollen the mouths of the wearers. This is done to make the women so hideous that other tribes would not want to steal them and to make the men appear more intimidating in combat. Have you seen the long-necked women in Africa? Since childhood, this has been accomplished by adding a new ring each year. The upper body is distorted as a result, and the neck appears longer.

We can observe how jewelry changed over time and ended up in jewelry stores by tracing its evolution from the ancient African world to the Mediterranean, then Europe, and lastly the United States.

Iran and the Mediterranean Region

The earliest evidence of jewellery dates back to the 3,000–400 BC civilizations that flourished in the Mediterranean and what is now Iran. Usually, they were just plain stone seals and amulets. Numerous amulets and seals were adorned with floral patterns, stars, and spiritual meanings. Statues were adorned with jewelry that was presented to the gods. Dating back to 3000 BC, the Royal Tombs of ancient Sumer have left us with the greatest collection ever discovered. There they found mummies encrusted with every imaginable type of jewelry worn: headdresses, necklaces, earrings, rings, crowns, and pins.

The earliest jewellery artifacts are from the Mediterranean and modern-day Iran civilizations, which flourished between 3,000 and 400 BC. Usually, they were just amulets and simple stone seals. Numerous seals and amulets were embellished with stars, flowers, and other spiritual symbols. Jewelry that was offered to the gods was used to adorn statues. Encompassing the largest ever uncovered collection, the Royal Tombs of ancient Sumer date back to 3000 BC. They discovered mummies covered in headdresses, necklaces, earrings, rings, crowns, and pins, among other types of jewelry.

The Egyptians

Moreover, amulets and talismans were worn by the ancient Egyptians. The scarab, a small beetle carved into a mummy, is a familiar sight from Mummy movies. The ankh, a symbol of life, was another recurring theme. A common type of jewelry that is even making a comeback in style is multistranded beads in different colors. The Egyptians fashioned bracelets out of various colored gemstone strains. Given how common these names are even now, you have probably heard of amethyst, carnelian, green feldspar, and turquoise

The cobra stood for Lower Egypt, and the vulture for Nekhbet, the patron deity of Upper Egypt, as the Egyptians employed symbols to express their sense of territorial pride. The royal jewellers worked with turquoise, amethyst, chalcedony, silver, gold, and lapis lazuli. Afghan miners were exchanged for lapis lazuli. Faience, a glass-like coating on clay and glass inlays, was another Egyptian invention that made them famous.

Colour symbolism was significant to the ancient Egyptians because they firmly believed that colours mirror aspects of our character. Gold and yellow, which were connected to the sun, were frequently utilised in the pharaoh's and his priests' crowns and decorations. The pharaohs' mouths were sealed with a green stone to enable them to speak again in the afterlife. The soul was said to be preserved by the red AB or heart amulet. Health and protection were offered by the golden Udjat.

Bahrain

Off the coast of Saudi Arabia, in the Persian Gulf, lies a level island called Bahrain. This was not an affluent and noble island. but a commoner's island where 170,000 graves have been found. Some date back as recently as 300 BC, but the oldest are close to 4,000 years old. These were common people who genuinely led comfortable lives. In an effort to learn more about these people's way of life, archaeologists have descended upon Bahrain. They found bronze axe heads and javelins, and they even found a 4,000-year-old pot traced to ancient Oman. But their real find was a 4000-year-old pearl and gold earring, the oldest ever found.

The Greeks

The Greeks were prolific writers who frequently discussed jewellery and how it affected their daily life. Greek jewellery dates back to 1200 BC and was a rich and varied reflection of the richness of the community. The Greeks first imitated Eastern Motifs before creating their own unique aesthetic in line with their deities and symbolism. Greek jewellery includes hairpins, necklaces, brooches, earrings, bracelets, rings, and crowns. It was common for Greek ladies to wear necklaces that had up to 75 little vases hanging from them. Their jewellery fused the Etruscan use of gold with the Eastern penchant for gemstones. Granulation is a technique for creating little gold beads that was perfected by the Etruscans.

The Romans

The majority of gem stones that are used now were found by the Roman era. The prevailing beliefs were based on myth and magic, and precious stones were revered. The Roman ladies would have worn hairpins long enough to be utilised for self-defense, thus they served another function as well! The cameo was likewise adored and treasured by the Romans for its aesthetic value. Necklaces, bracelets for the wrist and upper arms, and gold coin jewellery all gained popularity.

The Byzantine Empire

The Byzantine Empire has the richest jewellery tradition of any empire. Following the relocation of the capital to Constantinople in 330 AD by Emperor Constantine, the Byzantines inherited this prestigious status. Greece, Egypt, the Near East, and swathes of Russia and North Africa were all combined into one huge and prosperous empire. This mixing pot of ideas resulted in the employment of vibrant colours and eastern symbols, which persisted throughout the Middle Ages. Through marriage, trade, and conflict, their designs were brought westward into Europe. During the Byzantine era, glass glaze pouring and setting into pre-soldered patterns or cells, followed by a high-temperature firing to melt the glaze into a permanent design, was a popular art form known as cloisonné enamelling.

The areas ruled by Rome were enveloped in darkness upon its fall. Life was difficult, and in Europe, luxury like jewellery had all but vanished. The majority of the money was held by the church during this period. The holy realm possessed gem-studded altars, chalices, and icon missals (books used during mass) in the tenth century. Bands of soldiers visited the holy land during the Crusades and returned bearing enormous quantities of jewellery and gemstones. The majority of the looting went to the Church, however several items were distributed to the general public instead of the Church.

The Crusades

Since the Crusades were the first significant trade between the East and the West in many centuries, new avenues for trade and communication were made possible. It introduced novel goods and concepts to European consumers. Between the twelfth and the fifteenth centuries, very few peasants wore jewellery, with the exception of the occasional brooch or hatpin.

During the Middle Ages, the clergy and the royal family disapproved of commoners trying to dress or behave like them or wearing jewellery. The aristocracy thought that this was a unique privilege that only they could experience. Sumptuary laws were introduced in order to impose this concept. These restrictions limited what people might wear, so as to discourage luxury and encourage thrift. Wearing rings has significance and function.

There were four primary groups or objectives:

1. Religious rings that are worn as holy symbols by both clergy and laypeople.
2. Healing rings, intended to treat illnesses and conditions.
3. Romantic rings, the wedding band worn on the left second finger since it is so near the heart.
4. Compass rings, pipe stuffers, and brass knuckles are examples of gadget rings.

Henry VIII, the king of England, donned the most ostentatious apparel in the sixteenth century, despite the French setting the fashion trends. He flaunted 324 brooches, at least 234 rings, and necklets adorned with pearl and diamonds. Elizabeth I, his daughter, had almost 2000 gowns constructed, all of which were heavily embellished with pearls and gemstones, because she was such a pearl lover. Elisabeth was dressed in a manner appropriate for the time. The Spanish Queen also donned gowns that were highly pearl-embroidered and jewelled.

That was a quick review of jewellery history throughout ages [2, 3]

jewellery making techniques

3D Printing

Step 1 – Designing

Making jewelery is nothing less than a magical process! The complete jewellery design process entails numerous processes, from designing to creating models to doing a quality check at the end.

The initial step in the process of manufacturing jewellery is designing a design. During the designing phase, a jewellery designer takes an idea and, after additional study and evaluation, converts it into a workable design.

Step 2 – CAD/CAM

The CAD/CAM stage, which involves the usage of CAD software, comes right after the designing stage. Designers frequently utilise CAD software, a 2D and 3D computer-aided drawing programme, to increase the quality and dimensional accuracy of their designs. It also facilitates the building of a manufacturing database. When a jewellery designer completes the process of designing a concept, it is created both on paper and within the system.

The "concept on paper" to "system" translation is accomplished by use of computer-aided design, or CAD, software. The Computer Aided Manufacturing (CAM) programme manages the manufacturing and machining processes, or more accurately, it automates the production process.

Step 3 – Model Making

The Model Making is the next stage which involves the process of the conversion of resin output from CAM to silver model (a master design which is being used to create similar pieces of jewellery through the use of rubber mould) through the process of casting

Step 4 – Rubber Mould

The Rubber Mould step, which comes in at number four, is crucial to the production process. The Rubber Mould facilitates the production of numerous jewellery pieces with the same design. The nicest thing about the rubber mould is that the designs stay imbedded, safe, and secure, allowing for future creation of jewellery designs using the mould. The process of creating a mould is known as "vulcanizing," and the materials used can range from metal to silicone to natural rubber.

Step 5 – Waxing / Wax tree:

The creation of wax pieces is the following step in the jewelry-making process. Rubber moulds created from silver master are used to create the wax parts. Waxing is the method of creating wax models by pressing pressure into a hollow created by the rubber mould on the commercial wax injector machine. Casting is done using these wax replicas.

The process of soldering the wax parts onto a wax stem is known as "treeing." During the treeing process, a spruce is fastened to each wax piece at a about 45-degree angle with the stem. The heavier objects are positioned at the base of the tree, and the lighter ones are at the top.

Step 6 – Casting

The next phase of the jewellery manufacturing process at KOSH is casting, which is thought to be one of the trickiest procedures. Casting calls for knowledgeable and proficient casters. Placing the wax tree in a steel flask and adding a slurry of chemical powder—which takes about an hour to solidify—is the full casting process. The flask is then heated by placing it in an electric furnace. It causes the wax to melt and leave a tree cavity behind. After that, the molten metal is poured into the flasks and given time to cool. Following cooling and demolition, the molten metal is exposed as jewellery in the form of casting.

Step 7 – Grinding

The next step in the production process of jewellery is grinding. A polisher is used in the grinding process to remove the nub, which is the product of the casting process (the nub arises where the spruce was bonded with the gold piece after the raw casting is trimmed off from the casting tree). The polisher uses a motorised grinding machine to smooth the gold jewellery piece's surface. The last step in the polishing process is grinding, which is done by placing the jewellery piece up against a rotating grinding wheel to provide the necessary flat surface.

Step 8 – Filling and Pre Polishing

The following step in the production process of jewellery is called filing. The extra solder or metal is being removed from the object under Filing. A range of instruments, including files and burns, are employed to eliminate the casting layer and provide a polished appearance. Following filing, the process of assembling is completed, which entails using a soldering iron or laser to combine two or more components of the same design.

After that, polishing is done to give the jewellery item a polished and refined appearance, increasing its worth. Pre-polishing, super cleaning, and tumbling are the three steps that make up the polishing stage. It is important to remember that jewellery pieces including diamonds must be pre-polished before the diamond is placed. This is because cleaning the diamond segments after they are set below the area could jeopardise the diamond's lustre.

Step 9 – Metal Setting

The metal setting is the 9th stage in the manufacturing of jewellery. The metal setting is the process of setting or attaching the gemstone in the jewellery. The metal setting is varied in order to create different designs. Even the combination of different metal setting is used to give a captivating appearance to the jewellery piece. The metal setting is of various kinds as mentioned just above, and the long list of the setting includes prong, plate prong, pave, bezel, pressure, bead, flush, invisible, fishtail, miracle plate and channel.

Step 10 – Polishing

The jewellery is polished during the polishing stage, which is the last step. Following the stone setting process, polishing is done to give the jewellery a brighter sheen. The polishing can be done manually or with the aid of a machine. Soft buff, solid buff, hair buff, single line ball buff, coin buff, platinum polishing rouse, red and green rouse (to impart shine), black lustre (to remove casting or filling layers) and white lustre (to remove roughness) are some of the tools that the craftsmen use to assist them in manually polishing the jewellery.

Step 11 – RHODIUM Plating

The penultimate step in the production of jewellery is rhodium plating. Rhodium plating is the technique of applying rhodium, a shimmering white precious metal that gives jewellery a superior resistance to tarnish and scratches, to a piece of jewellery. While rhodium is applied to white gold to give it more whiteness (because white gold is not quite white), it is also used to create aesthetically pleasing designs and patterns on yellow gold.

Step 12 – Quality Control

The quality control step is the last and just as crucial as the previous steps in the production of jewellery. The step of quality control makes sure that the finished manufactured product satisfies standard standards and follows a defined set of quality rules. Three approaches are used in quality control: measurement, visual inspection, and mechanical inspection.[4, 5]

Traditional techniques

When it comes to materials and procedures, traditional jewellery manufacturing can be compared to a type of micro-engineering since it necessitates the extremely precise creation of metal items. The majority of jewellery is made of the precious metals silver, gold, platinum, and palladium, though it can also be made of steel or pewter, particularly for use in the tourism sector. Then, these metal pieces can be joined together to form chains, for example, or set with stones, polished, enamelled, or enamelled again. In the finest quality jewellery, several processes can be applied at once.

The primary methods employed can be categorised as follows:

Design:

working with a jeweller who is knowledgeable about the advantages and disadvantages of the particular materials used in jewellery as well as how the item fits the body.

Cutting and forming metal

the process of dividing metal into pieces or components that can be fashioned into jewellery. Although laser cutting is an alternative, piercing saws are typically used for the cutting. Forming, which includes hammering, bending, elevating over a stake, sinking, die-forming, and a variety of other techniques, is the shaping of the metal. The use of hand-pierced elements is a significant feature of Marianne Anderson's work. Kathryn Hinton makes her silver vessels by press-forming them using computerised techniques to create dies.

Soldering

the process of bonding metal with heat. There are several ways to accomplish this, but the most common one is to utilise a gas torch of some kind. In the jewellery studio, TIG and laser welding are being used more and more.

Casting

using wax models to make moulds that are subsequently filled with metal that has melted. This intricate and specialised procedure makes it possible to produce large quantities of units quickly or to produce quantities of units that would not be feasible otherwise. While many jewellers cast their own work, many prefer using specialised casting businesses. Waxes can be manufactured digitally or by hand by skilled wax carvers. Carol Docherty focuses in wax carving and is a skilled artist in this field of work. Argyll-based Carradale Foundry is a casting business that specialises in jewellery materials.

Stone-setting

Historically, this work would have been distinct from that of a "jeweller," but jewellers are increasingly training themselves in this ability. This is the process of setting gemstones into jewellery that is finished. There are still competent stone-setters out there, and many jewellers prefer to use these outside setters when setting a lot of stones or in specialised settings. Inness Thomson is an expert setter of stones.

Enamelling

This is the process of applying coloured glass that has fused to the surface to tint metal. Since it's a very sophisticated trade, most jewellers would contract this out to someone with more experience. It has experienced a resurgence in popularity in recent years.

Polishing

the completed jewelry's finishing process. This is essentially the final stage of production, and while most jewellers now polish their own pieces, there are still a small number of specialised polishers in cities like Birmingham and London.[6, 7]

Materials

Jewellers have been using nearly every kind of metal available to them for their creations from the beginning of time. They welcome the introduction of new metals and alloys, such titanium and stainless steel. Jewellers repurpose them to make exquisite creations by altering them. Trendy metals are used in fashion, but fads come and go. But three jewellery metals—gold, silver, and platinum—have weathered the test of time and are still widely used in contemporary jewellery.

Noble Metals

Noble metals are chemically resistant to corrosion and oxidation in damp air. Additionally, they differ in how resistant they are to acids. The elements ruthenium, rhodium, palladium, osmium, iridium, gold, silver, and platinum are included in this group.

Apart from the attributes of noble metals, gold, silver, and platinum have the following qualities:

1. Although these metals are found all over the world, their abundance does not make them less valuable.
2. They have been used as money and are regarded as precious metals (a store of value).
3. The fact that these metals are regarded as gorgeous, sensual, and glamorous by many civilizations both historically and presently adds to their allure.
4. These metals are useful options for jewelry-making because they are also malleable.

Due to all of these factors, platinum, silver, and gold are still very popular metals for jewellery.

Gold

Gold has long been prized for its beauty, but it also has physical qualities that have drawn people in. A lot of jewellery designers and producers favour gold over other metals since it never tarnishes and is very workable. It is indeed possible to stretch one ounce of gold into a thread that is more than fifty kilometres long. That amount can also be rolled into a sheet that is 100 square feet in size. Gold is a precious metal to both designers and consumers because, with proper maintenance, it may last forever. It is resistant to oxidation and corrosion and can only be harmed by a few uncommon acids or hot chlorine bleach.

According to recent research, gold may have formed billions of years ago in the remote reaches of the universe. When Earth was first formed, it came as dust. Gold has undergone a lot of changes over the years, and jewellery fashioned of it can still do so. By melting down old gold artefacts and reconstructing the gold into new pieces, gold can be reused. For instance, broken jewellery and old coins can be melted down and used again to create new gold jewellery

Gold Alloys

Although gold has many attractive qualities, one major disadvantage is its softness. This indicates that it ages quickly. This characteristic is not the same as the hardness measured in gemology or mineralogy, which is resistance to scratches. Gold alloys, on the other hand, are stronger, more resilient, and more appropriate for use in jewellery when mixed with other metals. While pure gold is occasionally used by jewellers to create jewellery, most people don't often wear pure gold jewellery since it dents and shows wear so easily.

For jewelry-making, alloys of silver, copper, nickel, iron, zinc, tin, manganese, cadmium, and titanium are frequently combined with gold. Alloying modifies not only the strength but also some other characteristics of gold. Certain gold alloys, for instance, can result in skin stains or allergic responses. These reactions are not brought on by the gold itself. Instead, it's the alloyed metals.

Silver

Silver has been more valuable than gold at different points in history. Silver, which has been used for jewellery and as a medium of exchange for a long time, has numerous novel applications. These days, these include, to mention a few, magnetic strips, auto glass defogger, batteries, and photography.

Silver is one of the most used metals for jewellery for a number of reasons. Its most notable visual characteristic is its lustre. In addition, compared to gold or platinum, silver is far more affordable and more plentiful. Nevertheless, silver is harder to deal with than gold because of how effectively it transmits heat. Because of this, inexperienced jewellery designers frequently pick up soldering on silver. It gets easier to manage the heat on gold after they master their soldering method on this highly conductive metal.

Tarnish

However, there are several disadvantages to this noble metal. Silver, above all, tarnishes. A layer of corrosion known as "tarnish" develops on some metals, such as silver, as a result of chemical interactions. Silver tarnishes due to a chemical reaction that needs a substance known as hydrogen sulphide. Silver objects left out in the open will eventually tarnish because this chemical can be found in our air.

The quantity of tarnish on silver objects can be decreased by storing them in protective pouches or containers. This implies that polishing your silver jewellery will take less time and effort. Indeed, compared to certain other valuable jewellery metals, silver needs greater maintenance. Nonetheless, there are numerous ways to polish, ranging from DIY home techniques to silver polish that is sold professionally. Avoid being put off by tarnished silver jewellery.

Platinum

Platinum is more costly and rarer than gold, but it also has superior durability and holding strength. It doesn't tarnish. Due to these characteristics, it is one of the most sought-after and expensive metals for jewellery, particularly rings for engagement and marriage.

Additionally, platinum is used in many industrial applications, such catalytic converters. Actually, this uses up half of the platinum mined in the United States and a quarter worldwide. Platinum is also utilised by the U.S. Bureau of Standards for weights. These weights never change because this metal never oxidises.[8]

How technology affected jewelry (in materials, technologies and techniques)

The Link Between Design and Technology

The word "technology" encompasses both machine-based procedures and the superior handicraft abilities needed to make jewellery the old-fashioned way.

For either strategy to be effective, we must have a solid understanding of the characteristics and potential of gold.

Perhaps one particularly good example of hand skills in a technological sense is anticlastic raising. The only way to do it is to comprehend the material's mechanical behavior.

This is comparable to other types of artists, such as painters, sculptors, and potters. To express ideas in a desired way, a painter must have a thorough understanding of his or her materials and tools, including the canvas, paints and how they interact, different painting techniques, hand skills, the significance of light and perspective, color combinations, and so forth. The same holds true for someone who crafts ceramics as a potter or sculptor. Therefore, I believe it should be clear that a designer must possess a certain level of technical competence in order to create jewelry that is of a high caliber and that involves a solid understanding of the tools, materials, and techniques involved. The first and most obvious connection between design and technology is that the realization of a design concept depends on technology.

Here are some more things to consider in order to further clarify this: First of all, it is critical for jewelry designers to comprehend the different technologies and the possibilities and constraints they present for their work. Many jewelers and goldsmiths will have worked with intriguing "paper" designs created by designers that are not economically feasible to produce. In a similar vein, a lot of investment casters will have dealt with pieces intended for investment casting but that cannot be cast.

It is imperative that producers achieve a high level of physical quality in their jewelry products as well as high-quality construction and finishing are necessary for the design to be deemed successful.

Technology is also needed for this, including both production and material technology.

While discussing jewelry design, it is important to remember two aspects of design: the creative approach, which is the way most of us think of jewelry design and where most computer-aided design (CAD) systems have their origins; and the growing use of CAD by designers, which emphasizes how technology can expedite and facilitate artistic design; of course, the complementary Rapid Prototyping technology helps with speed to market.

However, we must not overlook the engineering dimension of jewelry design; jewelry must be serviceable and fit for the purpose for which it is intended, as well as strong enough to withstand the handling it receives. Some jewelry, such as herringbone chains, must be flexible and not kink during use, and spring catches must be durable and operate reliably. 2D-designing jewelry for ease of manufacture is another dimension to this.

There must be a connection between innovative design and technology because technology is an essential part in achieving innovation in design.

Those connections can be listed in:

1. design must be used and understood in its practical context, which includes knowing technology in relation to production processes and materials.
2. Design requirements can encourage the creation of more advanced technology.

Technology Creating New Possibilities for Design

There are many technologies that helps in jewelry field some of them are old, new and there is more that’s is up to date

Some of these technologies are:

Electroforming

While this technology has been available for a while, it has recently seen significant advancements. For imaginative designers, electroforming presents exceptional prospects, and several jewelry producers

Visualizing electroforming as a distinct process rather than just a stand-in for other procedures like stamping or lost-wax casting is crucial, as each method offers advantages over the other from the perspective of design.

Electroforming is the best method for creating thin, hollow, lightweight, voluminous, and complex three-dimensional structures. It can make designs that are not achievable with conventional methods more inexpensive.

It also makes it possible for the artisan to produce one-of-a-kind jewellery, as one can imitate natural elements such as leaves, flowers, shells, nuts, and cobwebs, or fashion intriguing shapes out of man-made things.

Cable-making

One relatively new process technology in the jewelry industry is cable-making, which is basically spinning a lot of wires together in a helical pattern. One recent trend is the use of gold cables instead of chain for neckwear, especially to support pendants. This presents an opportunity for designers to deviate from the traditional chain neckwear design philosophy. The technology for cable-making was originally developed for the electrical cable industry and is now tailored to the needs of the jewelry industry. Consider how using different colored carat gold wires in cable-making provides an intriguing design option. Perhaps using wires in Spangold shape memory material could result in an intriguing surface texture!

Knitting and weaving

The knitting of precious metal wires to create knitted metal fabrics is another process technology that is new to the jewelry industry. Chain-making technology is also used to create similar chain-mail type fabrics. Several knitted examples were among the prize-winners of the Gold Virtuosi design competition, illustrating the design opportunities available. In addition, these technologies, like knitting in wool, could be used to knit coloured gold and other combinations of precious metal wires into unique patterns, thereby extending the design opportunities.

Powder metallurgy

The production of wedding rings from powdered precious metals is a relatively new development. The advantage of using powder metallurgy to create net-shaped components is that it reduces scrap, which is expensive in the precious metals industry. Engelhard UK invented this technology by using water-atomized powders of carat golds, silver, and platinum in a "press and sinter" method. The rings that are produced are superior in quality and can be produced more quickly and affordably.

Laser technology

In the process of making jewelry, laser technology is being utilized more and more for embellishment via laser engraving in addition to cutting and welding.

Unexpectedly, the idea of using laser welding to produce jewelry in large quantities with a granulation design has not yet been commercialized.

This is an antiquated method brought into the modern era!There are many more technologies other than those listed above, But to get to the point, technology affected both materials and techniques in jewellery field

As for materials there are many technologies such as :

Micro-alloyed 24-carat golds

We often overlook the limitations that technology places on jewelry design. For example, the soft and weak nature of pure 24-carat gold prohibits its use in the production of certain items; 24K chain necklaces and bracelets are typically joined by a plain “S”-shaped hook. Fortunately, many of these limitations have been lifted with the introduction of stronger microalloyed 24-carat golds in recent years.

Spangold shape memory alloys

A range of unique shape memory-effect alloys in 18 and 23 carat golds exhibit a multicolored spangled surface upon heat treatment; this effect is most noticeable on large, flat or curved surfaces. The spangled surface results from a surface rumpling brought on by a shift in crystal structure, but it extends beyond the surface and is reversible throughout the bulk alloy.

Precious Metal Clays

A fascinating development is the new gold and other precious metal clays. These clays are made of metal powders in a binder and are literally similar to potters clay in that they can be molded using the same methods. They can also be molded in new ways and have the potential to be used for mass production of jewelry components and pieces using inexpensive, easily made tooling. The material produces a unique surface finish that can be polished to a traditional bright reflective surface. This material's potential to open up new design possibilities beyond what can be achieved by traditional goldsmithing[8-10]

Smart Materials

In the previous chapter, we talked about the impact of technology on raw materials, and as a result of the continuous development of technology, a type of material called smart materials began to appear

Smart materials

Materials that receive, transmit, or process a stimulus and react by creating a beneficial effect—which could include a signal indicating that the materials are acting upon it—have been added to the definition of smart materials. [11-20]

Strain, stress, heat, chemicals, electric fields, various radiation types, and others are some of the stimuli that could affect these materials.

The effect may result from a variety of processes, including proton absorption, chemical reactions, sequence integration, translation or rotation of molecular structure segments,

formation and motion of crystallographic defects or other localized conformations, modification of localized stress and strain fields, and others.

A change in color, an adjustment to the index of refraction, a modification to the distribution of stresses and strains, or a change in volume can all result from the process.

The ability to receive stimuli and respond to them in order to produce a useful effect—which needs to be reversible—is another crucial component of a smart material.

The asymmetrical nature of a material is another characteristic that plays a significant role in determining its intelligence.

For the piezoelectric materials in particular, this is crucial.

This property is also present in other kinds of smart materials.

Nevertheless, not much research has been done to support this observation.

Furthermore, it should be noted that smart materials are referred to as intelligent.

The term "smart" has been overused to promote goods and materials.

Materials that formally have the label of being “smart” include piezoelectric , electrostrictive , electrorheological , magnetorheological , thermoresponsive , ph-sensetive , ultraviolet sensitive , smart polymers, smart gels , smart catalysts and shape memory alloys

Another important feature of smart materials is their inclusion in structures. We call these intelligent structures. Simply put, smart structures are those that have at least one smart material integrated into them, and the effect of the smart material results in an action. Actuators (muscles), controls (brain), and sensors (nerves) can all be found in a smart structure. As a result, the term "biomimetric" is related to intelligent structures. Intelligent systems are being developed to improve our quality of life and productivity. And these structures are getting more and more noticeable because of the abundance of sensors, actuators, and control systems that are available, as well as the materials and the brilliance of scientists and engineers. This can be confirmed by visiting stores, watching television, and reading nontechnical magazines.

The fact that smart materials and structures span all scientific and engineering domains is another crucial aspect of them. Thus, there are many publications, websites, and trade associations that deal with the technology to consult when looking for information on smart materials and structures.

Types and structure of some of smart materials

PIEZOELECTRIC Materials

By first separating the terms piezo and electric, the definition of piezoelectric materials can be obtained in its most basic form. The word piezo comes from the Greek piezein, which means to squeeze or press firmly. "Squeeze electricity" is created by combining electric and piezoelectric elements.

The term "direct-pressure electric piezoelectric effect" now refers to this phenomenon.

Many naturally occurring crystals, including sodium potassium tartrate, quartz, and tourmaline, have the piezoelectric effect. A crystal must lack a centre of symmetry in order to display the piezoelectric effect. A crystal with a centre of symmetry will exhibit a net polarisation at its surface when a tensile or compressive stress is applied, which will change the distance between the positive and negative sites in each elementary cell unit. The impact is roughly linear. The imposed stress has a direct impact on the polarisation. It depends on the direction. Electric fields and voltages of opposing polarity will therefore be produced by compressive and tensile forces. Because the action is reciprocal, the crystal fluoride will be at ambient temperature.

But at higher temperatures, the polyimides' piezoelectric response increases.

Because of the complementary effects of nonpiezoelectric polymeric materials' low density and the piezoelectric activity of monolithic ceramics, multiphase piezoelectric composites have been produced. Smart-tagged composites are one type of piezoelectric composite that has been created. Utilised for monitoring structural health, these piezoelectric composites consist of PZT-5A particles embedded in an unsaturated polyester polymer matrix. For microelectronic applications, conductive metal-filled particles with polyimide sheets have been investigated. Polyimides packed with graphite have demonstrated promise as microsensors and actuators.

The fact that piezoelectric materials are also pyroelectric should be highlighted. When their temperature changes, they produce an electric charge. A voltage that is parallel to the polarisation voltage arises whenever their temperature is raised. A voltage that is opposed to the polarisation voltage emerges whenever the temperature drops."

Piezoelectric polymers and ceramics can be used in ink-on-demand printing, among other applications. Due to the reduced level of hysteresis associated with motion, a number of commercially available ink jet printers are able to alter the position of optical components more easily than piezoelectric materials. On active optic systems, work has not stopped. The Hubble telescope's optical components were repositioned using similar multilayer actuators. Actuators and flexible mirrors are used by supermarket scanners to read bar codes visually.

Any polymer that can imitate electricity and react to its effects in a reversible way is considered an electroactive polymer. This category is similar to a melting pot of intelligent materials.

MAGNETOSTRICTIVE Materials

When a magnetic field is applied to magneto restrictive materials, the materials respond mechanically. Materials that are ferromagnetic and ferrimagnetic undergo the biggest shape alterations. Hysteresis between magnetization and an applied magnetic field results from the repositioning of domain walls that takes place when these materials are placed in a magnetic field. These effects vanish when the temperature of a ferromagnetic material is raised above its Curie temperature. A ferromagnetic solid has distinct microscopic characteristics from a ferrimagnetic solid. In a ferromagnetic material, the magnetic dipoles are parallel. In a ferrimagnetic material, dipole alignment can be perpendicular or in another direction.

In crystalline materials, magneto restriction has its maximum effect. The expense of magneto restrictive materials has been one of the obstacles keeping them from achieving practical significance. Giant magneto restrictive materials, massive magneto-restrictive materials, and organic and organometallic magnets have all undergone significant progress in the last thirty years.

In iron-chromium laminate, the enormous magneto restrictive effect was first noticed in 1988. These laminates were made of layers of chromium of varying thicknesses sandwiched between 50-Å-thick iron layers. The magnetic moments of the iron layers were antiparallel to one another. Applying a 20 kOe magnetic field in the iron layer plane will decouple this antiferromagnetic orientation. A magneto restrictive effect is produced when one layer's magnetic orientation is regulated, allowing another layer to rotate freely in response to an applied field. The higher sensitivity in the hard disc drive heads were improved at a reasonable cost by the discovery of gigantic magneto restrictive materials.

Commercially viable magnets should possess low-temperature operating coercive field and magnetic saturation characteristics. Below their critical temperature, magnets are useful. The critical temperatures of the majority of inorganic magnets are much higher than ambient temperature.

The ionic salt complex of tetracyanoethylene and ferric bis(pentamethylcyclopentadiene) was the first organometallic magnet.

There are two ways in which organic magnets differ from organometallic magnets. The first is readily apparent. Metal atoms are absent from organic magnets. This makes many people reevaluate the fundamentals of magnetism. The coupled spins of the organometallic magnets can dwell in either the p orbitals, the d orbitals, or a combination of the two, whereas the coupled spins of the organic magnets can only reside in the p orbitals. This is the second difference.

ELASTORESTRICTIVE Materials

The mechanical counterpart of electro restrictive and magneto restrictive smart materials is this class of smart materials. High hysteresis between stress and strain is displayed by these intelligent materials. The hysteresis is brought on by the ferroelastic domain walls moving. The ferroelastic domain walls move in a highly intricate and sophisticated way in the vicinity of a martensitic phase transition. There are two kinds of structural changes in the crystal at this phase transition. One is caused by motion of the domain wall, and the other by mechanical stress. Memory alloys structured like martensites can exist in both high- and low-temperature phases and exhibit broad, widespread phase transitions. When the temperature shifts completely to the high-temperature phase, the domain wall movements vanish.

We are in the early stages of the elastorestrictive smart material family.

ELECTRORHEOLOGICAL Materials:

A fascinating class of intelligent materials are the rheological materials. By applying an electric or magnetic field, materials classified as either magnetorheological or electrorheological can rapidly modify their rheological properties. For several millennia, electrorheological materials or fluids have been understood. An electric field is used to these fluids to alter their rheological or viscous properties, which are typically uniform dispersions or suspensions of particles inside a fluid. The working mechanism of these electrorheological fluids is straightforward. The particles organise themselves into formations resembling fibres (fibrils) when an electric field is introduced. The fibrils lose their orientation when the electric field is turned off.

The ability to switch between flexible and stiff damping qualities is another hallmark of electrorheological systems. A single-link flexible-beam test bed was used to assess the electrorheological fluids. Throughout its length, electrorheological fluids were arranged in a sandwich form within the beam. The electrorheological fluid was employed to give flexibility during the maneuver's transient reaction period for speed when the beam was being pushed quickly back and forth. At the maneuver's end, the fluid was made stiff for stability. Applying a fly fishing analogy to this behaviour is a useful perspective. Rheological fluids have been proposed for use in the construction of golf clubs and fishing rods.

MAGNETORHEOLOGICAL Materials

The magnetic counterpart of electrostatic fluids are magnetorheological materials or fluids. The applied stimulus in these fluids is a magnetic field, and the particles are either distributed or suspended ferromagnetic or ferrimagnetic. A basic magnetorheological fluid is motor oil mixed with iron particles.

An intriguing modification of magneto restrictive fluids consists of a range of elastomeric matrix composites that have iron particles implanted in them.

An insightful article from recently discussed efforts to improve the characteristics of epoxies using magnetic fields. The investigation did demonstrate that the final composite's properties were impacted by the low conversion rates of the epoxy with the hardener and the economically produced magnetic fields. The rare unreacted glycidyl and amine functions must be driven together at the high reactant conversion rate. And the only magnetic fields that can do this are those produced by superconducting electromagnets.

A lot of study is still being done on magnets and magnetism. Magnetic nanocomposite films are a new research focus. Size effects are observed in magnetic particles. Magnetic clusters consist of single domains below a threshold size, while bulk materials consist of numerous domains. The properties of nanomagnets are peculiar.

LIGHT-SENSITIVE Materials

A light stimulation can cause various material families to display distinct kinds of behaviour. A colour shift caused by an electrical field is known as electrochromic. Thermochromic, or colour change in response to heat, photochromism, or colour change in response to light, and photostrictism, or form changes brought on by modifications in electrical configuration brought on by light, are additional behaviours exhibited by light-sensitive materials.

Over the past few decades, electrochromic smart windows have been the subject of extensive research. For optical switching devices, more than 1800 patents have been granted; the majority of these have been granted in Japan. Typically, switchable glass has multiple layers and an integrated electrochromic device. Glass with an internal conductive oxide layer on both the top and bottom of a window de- vice is possible. The electrochromic device is located within the glass and conductive oxide sandwich. This device is made up of an ion conductor sandwiched between an ion storage layer and an electrochromic layer.

Li,VO2, an intriguing light-sensitive substance exhibiting thermochromism and electrochromism behaviours, was assessed for use in smart window applications."

Both photochromic and photographic (irreversible behaviour to light) behaviours have been created into materials. A polystyrene matrix encasing a substituted indolinospirobenzopyran serves as the foundation for one such system. At low UV exposure, this system functions as a photochromic system; at high UV exposure, it functions as a photographic system. Heat has the ability to devisualize an image, yet UV radiation can repeatedly restore it.

SMART Polymers

In this discussion of the subject, the phrase "smart polymers" was almost abandoned as a classification for smart materials. It's really perplexing. Every scientific and technical discipline defines a smart polymer differently, and each can fall under a different category. This can occasionally make the differences in smartness between them difficult to understand. Because the title of multiple outstanding publications mentioning smart polymers has been published, it is being added as a separate class.

Smart polymer systems in biotechnology and medicine typically refer to hydrogels, interfaces, and aqueous polymer solutions. Hydrogels and smart gels will receive different treatment. Polymeric systems referred to as "smart polymers" exhibit a robust response to even minute alterations in their external environment, resulting in a first-order transition and a precipitous drop in the polymer's specific volume. This transition, which alters the polymer's many properties, is called the glass transition temperature if the external medium is temperature.

These characteristics include permeability, modulus, heat conductivity, specific heat, volume, and coefficient of thermal expansion. Developing smart gadgets can be aided by manipulating the polymer's glass transition temperature detection. The failure of many product development projects can be attributed to the failure to consider the polymer's glass transition temperature. It should be mentioned that the polymer's below-glass transition qualities reappear as it cools down from high temperatures and approaches its glass transition temperature, and vice versa.

Temperature, pH, chemical species, light, UV radiation, recognition, electric fields, magnetic fields, and other stimuli are only a few examples of the stimuli that smart polymers can react to. Phase, form, optics, mechanical strengths, electrical and thermal properties, reaction speeds, and permeation rates can all vary as a result.

Smart (Intelligent) Gels (Hydrogels)

These clever materials go by a number of titles in the literature, as this section's title indicates. The idea behind smart gels combines the basic idea of solvent-swollen polymer networks with the material's ability to react to different kinds of stimuli. Temperature, pH, chemicals, solvent concentrations, ionic strengths, pressure, stress, light intensity, electric and magnetic fields, and various radiation types are a few examples of these stimuli.

Toyochi Tanaka, the man behind these smart gels, initially noticed this phenomenon in swelling transparent polyacrylamide gels. These gels would cloud and becoming opaque when they cooled. These gels regained their clarity when warmed.

These kinds of behaviours result in the creation of toys, chemical memory, optical shutters, controlled-release systems for pharmaceuticals and other substances, gel-based actuators, values, sensors, and artificial muscles for robotic devices. Additional systems that could be used in the development of products utilising hydrogels are paints, adhesives, bioreactors, recyclable absorbents, displays, and bioassay systems.

As for applications

There are many applications for smart materials such as:

Process	*Applications*
Load cells	*Force measurements* *Pressure measurements*
Velocity sensors	*Velocity measurements*
Accelerometer	*Acceleration measurements* *Vibration monitoring*
Structural monitoring	*Detection of acoustic emissions*
Hydrophones	*Monitoring of marine life, the heart , circulatory systems*
Igniters	*Gas ignition in welders, barbeques,lighters*
Remote controls	*Sensor in commercial remotes*
Microphones	*Detection of audible frequencies*

As well as soft robotics and many other things but in jewellery field there's a definition called smart jewellery which showed up as a result of the development of technology[10, 21-24]

Smart Jewellery

One of the biggest trends right now is wearable technology. Digital smart jewelry, also known as text "smart jewelry," is one of its subsets. These are visually appealing, jewel-like smart electronic devices that offer a variety of benefits to their users. A new product category without a well-established market is smart jewelry. As a result, there is a great deal of demand uncertainty. Although smart jewels are already available, their sales volume is still quite low. Why do not consumers purchase smart jewelry?

What is the general consensus regarding the technology-containing jewellery? However, given how quickly everything is becoming digital, it might not be long until jewellery starts to use digital technologies.

In 2012, various applications for the company's display technologies were developed in an invention workshop run by a technology company, which gave rise to the concept of smart jewellery. One of the concepts of the intelligent jewellery. Because one of the researchers participated in the session, smart jewellery innovation got underway. Seven smart jewellery ideation and brainstorming sessions were conducted in the beginning, yielding hundreds of concepts total. A shared notion of smart jewellery was developed through the concise written descriptions of the top 100 ideas. One description of a reminder necklace, for instance, was as follows: A person is reminded when to take their medication by the necklace. During the ideation phase, the smart jewellery was separated into two product categories: the stylish light jewellery and the functional jewelry

The best designs for smart jewellery were conceived, and then the best concepts were turned into prototypes. Some of the prototypes become big and heavy compared to typical conventional jewelleries by using easily available electronics. In several prototypes, solar cells were used as a renewable energy source.

The idea that smart jewellery is a so-called lofty concept tends to pique people's curiosity. Conversely, the astute jewellery vendors are already present in the market but have not yet achieved significant success. Both the markets and the products are currently in the lifecycle phase of introduction. Put otherwise, there is little market development for smart jewellery. With the exception of inexpensive baubles and toy jewellery, there is currently no market for smart jewellery, despite the fact that the technology is already available and trends appear to be heading in that direction.

People are particularly worried about technology's longevity, security, safety, and upkeep. Reducing these doubts should be the main goal of the marketing message. Of course, tradition also has a significant influence. It has a long history to jewellery. Making the abrupt leap to jewellery with electronics inside is a significant step. This will never be accepted by some individuals. It would be beneficial if a few large, reputable businesses began to place more of an emphasis on sophisticated jewellery.

It would also open doors for other business owners in the sector. Until recently, researchers and startups have primarily carried out the activist work of creating markets; but, in order to take the market to the next level, more potent market builders are now required.

Consumers anticipate experiencing aesthetic, functional, emotional, ecological, symbolic, social, and cultural value from smart jewellery. The way these parameters are weighed differs depending on the type of smart jewellery. However, the most common and significant value to potential users is the aesthetic value. Emotional and symbolic values come next. These three principles explain why jewellery may be preferred above other items that provide the same purpose.

For this reason, the majority of smart jewellery users will come from a subset of traditional jewellery consumers.

The consumer market for wearable technology and the Internet of things will likely lead to a growth in the smart jewellery market. One area that appears to be experiencing significant expansion is the healthcare and wellness sector. The number of diverse sensor technologies has grown and gotten significantly less expensive. In addition to their practical worth, individuals choose jewel-like gadgets over manufactured ones that could be linked to certain illnesses and instill guilt. It appears that this is the sole reason to get non-jewelry wearers to become wise jewellery users. The study indicates that there are numerous potential markets for smart jewellery that serves a purpose. Thus, there is a lot of business possibilities. [25-29]

Summery

In addition to being associated with wealth, value, social standing, aesthetics, and consumerist desire, jewellery and the idea of adorning the body have a long and well-documented history of carrying deeper emotional and intellectual meanings. Through their bodies of work, digital jewellery practitioners have investigated how technological advancements might be employed in the context of jewellery to create and strengthen emotional bonds by fostering a meaningful engagement between the user and the jewellery object. Some practitioners have even gone so far as to say that drastic changes and implanted jewellery will eventually cause the lines between the body and decoration to become indistinguishable.

Using smart materials and microelectronics, a variety of stimulus-responsive jewellery items have been created. However, it is still unclear how these wearable futures could be even more deeply ingrained into the wearer's body.

It is difficult for modern jewellers to advance the conversation about interactive adornment and the Posthuman, but there is potential for technology to become permanently interwoven into the intricate systems of the Posthuman body.

In this field of study, a challenge lies in the convergence of technical advancement, the investigation of smart materials, novel manufacturing techniques, and the creation of an aesthetic expression that transcends notions of basic gadgetry.

Conflict of Interest

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

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