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SMART MATERIALS- AN OVERVIEW

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Abstract : Smart Materials are also known as advanced materials or intelligent materials or responsive materials. These materials can be defined as advanced materials that can respond smartly to environmental changes. The general feature of all smart materials is the fact that one or more properties might be significantly altered under controlled conditions by external stimuli such as stress, moisture, electric fields, magnetic fields, light, temperature etc. This study focuses on Smart Materials types and applications in various fields.

Keywords: *Actuator, Piezoelectric, Sensors, Shape Memory Alloys, Smart Materials.*

I. INTRODUCTION

Smart Materials (SMs) are described because the substances that extrude their conduct in systematic way as a reaction to particular stimulus which might be altered. Thousands of years in the past humans used substances for extraordinary reasons because of which there has been an enhancement of their dwelling standards. Even civilizations have been divided on the idea in their discovery of substances just like the first age become the Stone Age. The maximum innovative age become the Bronze Age due to the fact Bronze become long lasting and harder. From the beyond decades, technological know-how and generation have made exceptional enhancements in synthesizing the brand new substances. They are divided in particular into four classes that are Polymers, Ceramics, Metals and Smart Materials. Smart Materials are getting greater famous due to the fact they've numerous programs in comparison to conventional substances. These unique substances can extrude their homes consisting of substances which could extrude its form simply via way of means of including a few warmth or can extrude its section immediately while positioned close to magnet. The new generation of Smart Materials can have a exceptional effect on mankind, as an example a number of them can extrude their homes in line with the surroundings and a number of them have sensory skills a number of them can restore mechanically and a number of them have self-degradation, those amazing skills of Smart Materials can have an effect on all elements of civilization.

I. CLASSIFICATION OF SMART MATERIALS

Smart Materials are categorised on the premise in their residences consisting of Active and Passive. Active Smart Materials own the functionality of editing their geometric and cloth residences beneath the software of electric, thermal or magnetic fields there via way of means of obtaining an inherent capability to transduce energy. Passive Smart Materials lack the inherent functionality to transduce energy. The 3 primary additives of clever gadget are sensor, processor and actuator.

II. TYPES OF SMART MATERIALS

All types of Smart Materials can think on their own and have mental alertness, quick perception, speed activity, effectiveness, spirited liveness and intelligence. The different types of Smart Materials are:

A. Shape Memory Alloys (SMAs)

Shape Memory Alloys are a unique class of metal alloys that can recover apparent permanent strains when they are heated above a certain temperature.



Fig. 1: Two Phases of SMA

A phase transformation which occurs between these two phases upon heating/cooling is the basis for the unique properties of the SMAs.

B. Piezoelectric Materials

The term piezoelectricity is a blend of two terms: “piezo” which is a Greek term meaning pressure and “electricity” referring to electric charges. By the application of stress or strain piezoelectric material changes the mechanical energy into electrical energy and vice-versa. Similarly, piezoelectric actuators convert electrical signals into a mechanical movement which is used for adjusting mirrors, lenses and various automotive parts.

C. Magneto-Rheological Fluids

Magneto-Rheological Fluids (MRFs) will alternate their rheological homes like pressure and viscosity at the software of the magnetic area. Magneto-Rheological Fluids (MRFs) also are known as Magneto-Sensitive Smart Materials. Magneto-Rheological Fluids (MRFs) have the homes consisting of visco-elastic in nature, magnetic property, mild in weight, controllable modulus and exquisite sound absorbing.

D. Electro-Rheological Fluids

The Electro-Rheological Fluids (ERFs) is the suspension of very small debris in electric insulating fluid whilst the electrical area is applied, they may swiftly shape a solid-like shape with inside the path of the area. Electro-Rheological Fluids (MRFs) have the homes consisting of stiff, damping coefficient is modified with inside the electric powered area, excessive dielectric constant, interfacial bond strength, constable rheology and dielectric in nature.

III. APPLICATIONS OF SMART MATERIALS

A. Application of Shape Memory Alloys (SMAs)

Shape Memory Alloys has extensive packages in numerous fields like Biomedical, Aerospace, Robotic, Automotive etc. Shape Memory Alloys had been utilized in robot software on account that 1980s. However, the robots may be divided into numerous organizations relying on their motion strategies and packages, as an example jumper, crawler, fish, walker, flower, scientific and biomimetic robot hand. Muscle cord is a NiTi alloy which may be stretched upto 8% of its duration and nevertheless recover. When a small cutting-edge is exceeded thru the cord it turns into a great deal tougher and go back to its unique duration with an inexpensive force. A battery and transfer are related to muscle cord and a small weight stretches the muscle cord. A smart use of muscle cord and a micro-controller circuit is a ‘Robotic Hand’. A robot hand has stretched muscle wires connected to the bottom of every finger. When cutting-edge is implemented to the muscle cord it contracts to its herbal duration with the aid of using pulling at the regular cord. The micro-controller is programmed to offer 5 of the outputs with activate and rancid options. This makes the palms of the hand move.

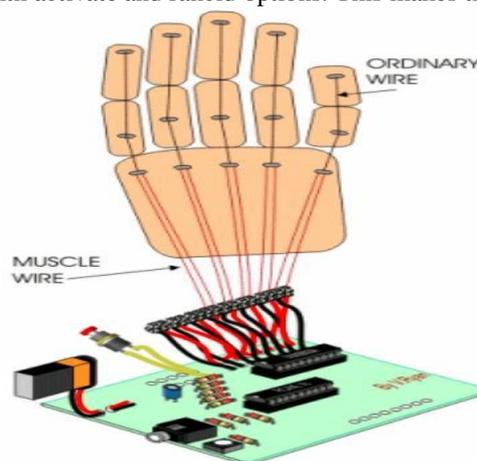


Fig. 2: Application of SMA in making Robotic Hand

B. Application of Piezoelectric Materials

In lighters or transportable sparkers with a piezo fuze a surprising and sturdy strain is used to supply a voltage. The spark then ignites the gas. A piezo motor is primarily based totally at the extrade in mechanical form of a piezoelectric cloth while an anxiety is implemented. The cloth produces ultrasonic or acoustic vibrations and produces a linear or rotary motion. Piezo factors are utilized in track for acoustic devices. They are inserted in stringed devices consisting of guitar, violin. The dynamic deformation/vibration of the cords is transformed right into a small alternating voltage.

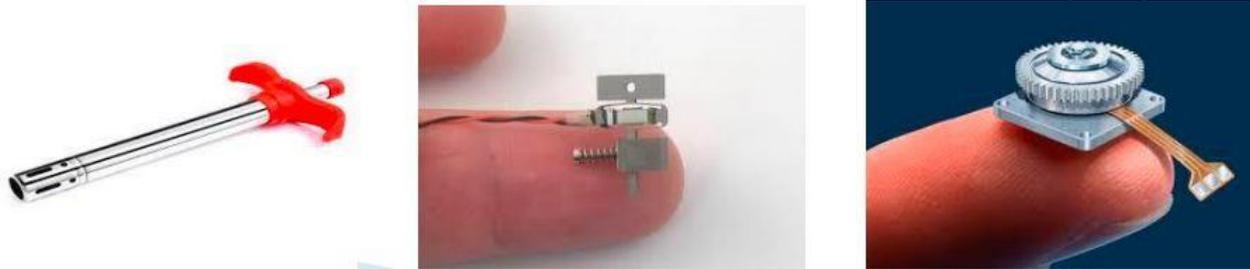


Fig. 3: Application of Piezoelectric Materials

C. Application of Magneto-Rheological Fluids

Magneto-Rheological Fluids have extensive software Automotive Industry, Civil Engineering, Household Appliances, Biomedical etc. The MR fluid damper is used withinside the washing device to lessen vibrations at some point of spin. The software of semi energetic manage in family packages continues to be an extended manner journey; the discussions are best in the ones regions wherein the studies is frequently approximately bathtub dynamics at low spin, approximately the principle drum's resonance frequency. Instead, this paintings in particular specializes in the vibrations induces because of excessive rotational velocity..

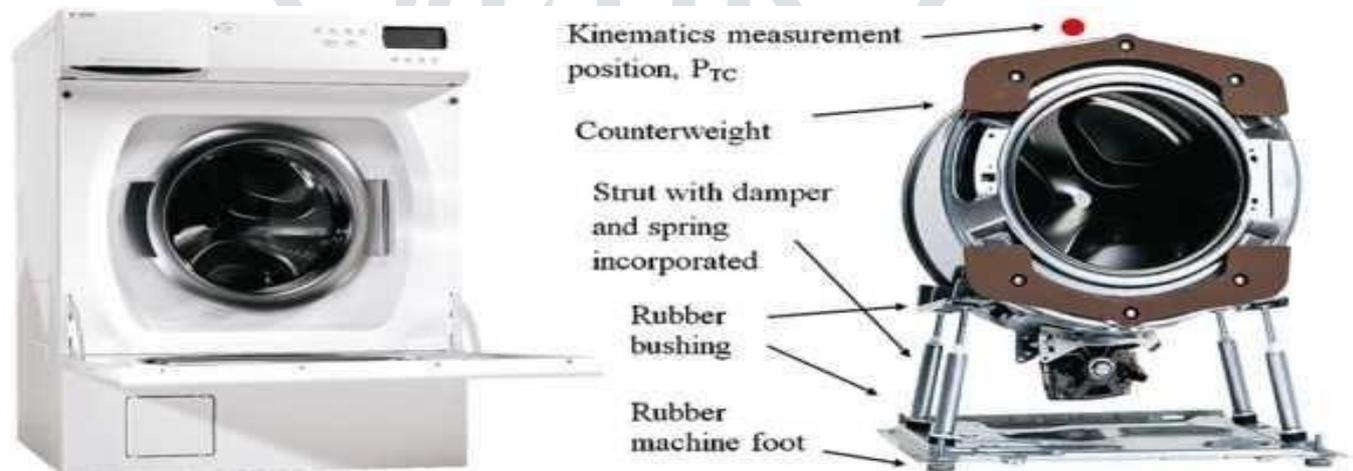


Fig. 4: Application of Magneto-Rheological Fluids in Household Appliance

D. Application of Electro-Rheological Fluids

There are numerous packages of ERFs in vibration isolators, the automobile industry, surprise absorber, clutch. They also are utilized in constructing base-isolation and electro-energetic actuators because of their cappotential to conquer defects due to particle aggregation and sedimentation that impacts the electro-rheological overall performance of ERFs constructing base-isolation and electro-energetic actuators due to the fact they could conquer the defects because of particle aggregation and sedimentation that adepts the electro-rheological overall performance. Electro-Rheological Fluids have extensive software in Hydraulic Industry, Automobile Industry, Fluid Sealing Industry, Robot Industry.

E. Application of Optical Fiber

Fiber optic cables discover many makes use of in a extensive form of industries and packages. Some makes use of of fiber optic cables include: Medical, Defense, Data storage, Telecommunications, Networking and Broadcast. Optical Fiber cables are used to transmit excessive definition tv indicators that have extra bandwidth and speed. Optical Fibre is inexpensive as compared to the identical amount of copper wires. Broadcasting groups use optical fibres for wiring HDTV, CATV, video-on-call for and plenty of packages.

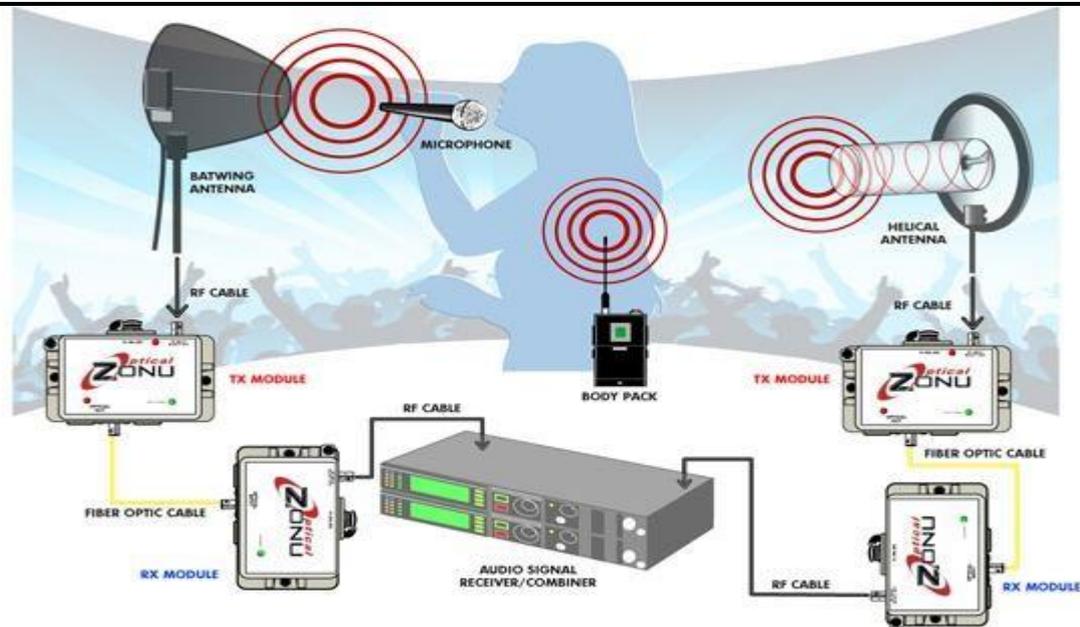


Fig. 5: Application Optical Fiber in Broadcast Industry

IV. CONCLUSIONS

The technology of smart materials by its nature, is a highly interdisciplinary field. Starting from the field of basic sciences such as physics, chemistry, mechanics, computing and electronics it also covers the applied sciences and engineering such as aeronautics and mechanical engineering. Understanding and controlling the composition and microstructure of any new materials are the ultimate objectives of research in this field and is crucial to the production of good smart materials.

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