EC IA-2

on

Framing Multiple Choice Questions

Submitted By Group Number: C5 Group 6 (51 to 60)

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Field	Details
Question	**Which type of polymers are used as organic substrates specifically for electrical signal transduction in MEMS?**
Options	A. Photo-polymers
	B. Conductive polymers
	C. Ferroelectric polymers
	D. Electrostrictive polymers
Correct Answer	**B. Conductive polymers**
Explanation	Conductive polymers are the organic materials that conduct electricity; thus, they are useful in MEMS for signal transduction. The conductive polymers facilitate effective signal transfer across MEMS devices and are capable of being molded into various shapes, which is particularly beneficial in miniaturized systems, hence making it the best polymer type for electrical signal transduction.
Reference	MEMS & Microsystems Design and Manufacture by *Tai- Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

SOMAIYA VIDYAVIHAR UNIVERSITY
K J Somaiya College of Engineering

Field	Details
Question	**Which type of MEMS device is often utilized for measuring temperature in healthcare applications?**
Options	A. Thermistors
	B. Micro thermocouples
	C. Capacitive Temperature Sensors
	D. Infrared Temperature Sensors
Correct Answer	**B. Micro thermocouples**
Explanation	Micro thermocouples are designed for temperature measurement. These have wide-ranging applications in the medical sector because of their small size, fast response, and accuracy. MEMS based thermocouples can be utilized in medical applications because they have compact size in being integrated into reliable devices, which provide necessary temperature measurements to monitor the patients.
Reference	*https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S* *https://www.mdpi.com/1461918*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Which of the following is a primary benefit of miniaturization in MEMS?**
Options	A. Higher energy consumption
	B. Reduced production cost
	C. Increased device size
	D. Limited processing speed
Correct Answer	**B. Reduced production cost**
Explanation	Miniaturization in electronics often leads to a reduction in production cost. Smaller components require less material and often allow for streamlined manufacturing processes, reducing overall expenses while also enhancing performance, energy efficiency, and portability in devices.
Reference	*https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S* *https://www.google.co.in/books/edition/Fundamentals_of_Microfabrication/90ZZDwAAQBAJ?hl=en&gbpv=1*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

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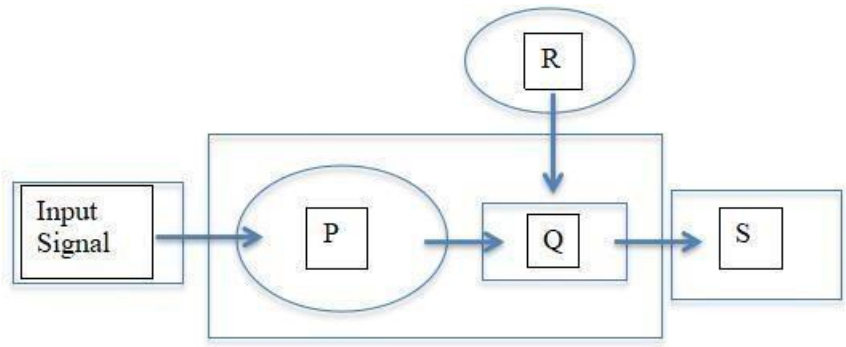
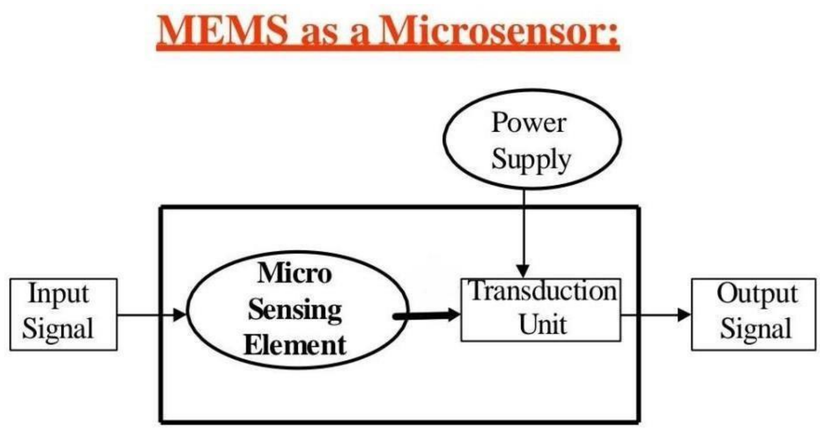
<tr><th>Field</th><th>Details</th></tr>
<tr><td>Question</td><td>
The above chart is MEMS as a micro-sensor. The “Q” represents the. . .?</td></tr>
<tr><td>Options</td><td>A. Power Supply</td></tr>
<tr><td></td><td>B. Micro Sensing Element</td></tr>
<tr><td></td><td>C. Transduction Unit</td></tr>
<tr><td></td><td>D. Actuator</td></tr>
<tr><td>Correct Answer</td><td>C. Transduction Unit</td></tr>
<tr><td>Explanation</td><td></td></tr>
<tr><td>Reference</td><td>https://drive.google.com/drive/folders/1pFOW1dUfj4s-utozyZLXkldBGQ6Eh85S book by Tai-Ran-Hsu</td></tr>
<tr><td>Module/Topic</td><td>Material in Engineering applications 2.4

(Materials for MEMS and Microsystems)</td></tr>
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Field	Details
Question	**What material is commonly used in LB films for applications like sound transducers and tactile sensors?**
Options	A. Polyvinyl chloride (PVC)
	B. Polytetrafluoroethylene (PTFE)
	C. Polyvinylidene fluoride (PVDF)
	D. Polyethylene terephthalate (PET)
Correct Answer	**C. Polyvinylidene fluoride (PVDF)**
Explanation	PVDF is a piezoelectric polymer widely used in Langmuir-Blodgett (LB) films for sound transducers, tactile sensors, and others. The piezoelectric properties of PVDF are such that it will make mechanical energy into electrical signals, which is a requirement for the type of sensors cited. Options other than PVC, PTFE, and PET do not possess piezoelectric capability.
Reference	MEMS & Microsystems Design and Manufacture by *Tai- Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s-utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

SOMAIYA VIDYAVIHAR UNIVERSITY
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Field	Details
Question	**Which unique property of PDMS makes it particularly suitable for applications in BioMEMS devices that involve gas exchange, such as oxygen delivery in cell culture systems?**
Options	A. High Young's modulus
	B. Optical transparency
	C. Gas permeability
	D. High refractive index
Correct Answer	**C. Gas permeability**
Explanation	PDMS has extremely high gas permeability; it allows the easy diffusion of gases such as oxygen and carbon dioxide. In BioMEMS applications involving cell culture systems, for instance, this property is a very important factor. Gas exchange is one of the necessary factors for cell viability. Other properties, such as optical transparency and mechanical strength, may be desirable but are unrelated to gas exchange concerns.
Reference	*Mems for Biomedical Applications. (2012). United Kingdom: Woodhead Publishing.* *https://www.google.co.in/books/edition/Mems_for_Biomedical_Applications/8s5ZAgAAQBAJ?hl=en&gbpv=0*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Which type of energy conversion is commonly used in microactuators for precise movement?**
Options	A. Chemical to Thermal
	B. Electrical to Mechanical
	C. Thermal to magnetic
	D. Light to chemical
Correct Answer	**B. Electrical to Mechanical**
Explanation	Microactuators typically convert electrical energy to mechanical movement. This allows for controlled and precise movements on a small scale, necessary in microsystems.
Reference	*Microelectromechanical Systems (MEMS) (reference pdf)* *https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

SOMAIYA VIDYAVIHAR UNIVERSITY
K J Somaiya College of Engineering

Field	Details
Question	**Which of the following statements are false with respect to major technical issues involved in the application of MEMS in bio-medicine?**
Options	A. Controllability, mobility, and easy navigation for the operations such as those required in a laparoscopy
	B. Adaptivity to existing instruments and equipment
	C. Compatibility with biological system of patients
	D. None of the above statements is false
Correct Answer	**D. None of the above statements is false**
Explanation	All of the following statements are true for the reason that all these options point to real technical challenges in applying MEMS in bio-medicine: Controllability and Navigation: MEMS devices have to exhibit smooth motion and easy control, especially for very precise procedures like laparoscopy. Adaptivity to Existing Tools: MEMS should easily work with the tools of the present; otherwise, its integration will be a problem. Compatibility with Body: MEMS must be harmless to the human body to prevent any adverse reactions.
Reference	MEMS & Microsystems Design and Manufacture by *Tai- Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s-utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Where is Silicon primarily used in microelectronics?**
Options	A. Integrated circuit carrier
	B. Thermal insulator
	C. Signal amplifier
	D. Fluid conductor
Correct Answer	**A. Integrated circuit carrier**
Explanation	Silicon is primarily used as a carrier for integrated circuits in microelectronics. For micro-systems, it is the preferred material for sensors and actuators, as well as common substrates for micro-fluids. Silicon's thermal stability and semiconductor properties make it ideal for creating the base layers for Integrated Circuit Carriers.
Reference	MEMS & Micro-systems Design and Manufacture by *Tai- Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Bio Sensors work on the principle of:**
Options	A. Chemical Analysis
	B. Bio-recognition and Signal Transduction
	C. Electrical Induction
	D. Mechanical Motion Detection
Correct Answer	**B. Bio-recognition and Signal Transduction**
Explanation	Biosensors work according to the principle of sensing specific biological molecules (bio-recognition) and changing this biological response into some observable signal (signal transduction).
Reference	MEMS & Microsystems Design and Manufacture by *Tai- Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s-utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Which type of MEMS device is particularly advantageous for continuous glucose monitoring in diabetic patients?**
Options	A. Micro-valves
	B. Micro-needle arrays
	C. Inertial sensors
	D. Optical tweezers
Correct Answer	**B. Micro-needle arrays**
Explanation	Micro-needle arrays are especially beneficial for continuous glucose monitoring in diabetic patients because they can painlessly penetrate the skin to access interstitial fluid, where glucose levels can be measured.
Reference	*https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S* *https://www.researchgate.net/publication/328489240_Microneedles_for_Transdermal_Drug_Delivery_A_Systematic_Review*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Miniaturization in microelectronics is crucial for the advancement of which emerging technology?**
Options	A. Blockchain
	B. AI and Robotics
	C. Fiber Optics
	D. Pneumatics
Correct Answer	**B. AI and Robotics**
Explanation	By making electronic components smaller and more efficient, it allows robots and AI driven devices to operate more effectively in compact spaces, using less power while delivering higher processing speeds. This has applications in everything from mobile robots to autonomous drones and wearable AI devices, consumer products and healthcare.
Reference	*https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S* *https://www.google.co.in/books/edition/Fundamentals_of_Microfabrication/90ZZDwAAQBAJ?hl=en&gbpv=1*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Which property makes micro-sensors using conductive polymers particularly sensitive for environmental conditions?**
Options	A. High flexibility
	B. Reversible absorption of gas species
	C. High temperature resistance
	D. Controlled refractive index
Correct Answer	**B. Reversible absorption of gas species**
Explanation	Conductive polymers are very sensitive to environmental conditions because they can absorb and desorb various gas species reversibly. These characteristic changes the conductivity of the polymer based on environmental factors like humidity or gas concentration, making them ideal for microsensors in environmental monitoring.
Reference	MEMS & Microsystems Design and Manufacture by *Tai- Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s-utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**What is Micromachining?**
Options	A. Process of creating large scale mechanical parts for industrial machinery
	B. Set of design and fabrication tools that precisely form structures and elements at a micro-scale
	C. Method used for arranging electronic devices by manual tools
	D. Technique used for designing large automotive parts
Correct Answer	**B. Set of design and fabrication tools that precisely form structures and elements at a micro-scale**
Explanation	Micromachining is defined as the process of making the minute physical features of a device. This can be done through various forming techniques including laser machining, chemical etching, and lithography which are conducted in very-layered environments. These technologies are used frequently in MEMS or microelectromechanical systems, and biomedical technologies. The other alternatives are poorly explained methods describing processes of a macroscopic nature which are indifferent to the concept of micromachining.
Reference	*Introduction to MEMS by SATISH KUMAR* *https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Which method is primarily used for creating strong, hermetic bonds between Pyrex glass and Silicon in MEMS devices?**
Options	A. Plasma-Assisted CVD
	B. Anodic bonding
	C. Ion beam etching
	D. Deep reactive ion etching (DRIE)
Correct Answer	**B. Anodic bonding**
Explanation	Anodic bonding is one of the techniques which use heat, pressure, and an electric field to bond Pyrex glass with Silicon. This enables a very strong and hermetic seal, important when functionality depends on a vacuum or sealed environment inside MEMS devices. Other methods like Plasma-Assisted CVD do not bond materials such as Pyrex glass with Silicon, but have been defined for thin film depositions.
Reference	*Microsystems, MEMS-applications, manufacturing methods for MEMS ~ Kari Vierinen Metropolia University of Applied Sciences Research Gate Paper* https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**In MEMS, which principle is used to detect mechanical displacement?**
Options	A. Chemical Reactions
	B. Radio frequency Waves
	C. Magnetic Fields
	D. Electrostatic Forces
Correct Answer	**D. Electrostatic Forces**
Explanation	Capacitive sensors in MEMS use electrostatic forces to detect changes in position or displacement, as changes in distance between electrodes alter the capacitance.
Reference	*Working Principles of MEMS & Microsystems* *https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**What are the great challenges faced by engineers in Bio-MEMS?**
Options	A. Knowledge in molecular biology is required
	B. Knowledge in physical chemistry is required
	C. Both (a) and (b)
	D. Knowledge of organic chemistry is required
Correct Answer	**C. Both (a) and (b)**
Explanation	Bio-MEMS present a great challenge to engineers, as the design and manufacture of this type of sensor and instruments require the knowledge and experience in molecular biology as well as physical chemistry, in addition to engineering.
Reference	MEMS & Microsystems Design and Manufacture by *Tai- Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s-utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Which fabrication technique is critical in the development of MEMS devices for ensuring high precision and reliability?**
Options	A. Bulk micro-machining
	B. Chemical vapor deposition (CVD)
	C. Screen printing
	D. Injection molding
Correct Answer	**A. Bulk micro-machining**
Explanation	Bulk micro-machining is a process used in MEMS to create precise and reliable structures by etching into a material. This technique allows for the production of complex, tiny parts that are important for the high precision and reliability needed in MEMS devices.
Reference	*https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S* *https://www.researchgate.net/publication/380762138_Microfabrication_techniques_and_technology*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Which of the following chemical sensors has the incorrect working principle?**
Options	A. Chemi Resistive Sensors - Organic polymers are used with embedded metal which on exposure to reactions, change their electric conductivity of the metal
	B. Chemi Capacitive Sensors - Capacitance of the capacitor changes on exposure of the metal plates to the reactions
	C. Chemi Mechanical Sensors - Certain polymers change their mechanical properties when they are exposed to certain chemicals
	D. Metal Oxide Gas Sensors - Metallic Sensors on exposure to certain gases form oxide layers, resulting in change in resistance
Correct Answer	**B. Chemi Capacitive Sensors - Capacitance of the capacitor changes on exposure of the metal plates to the reactions**
Explanation	Some polymers can be used as the dielectric material in capacitor. The exposure of these polymers to certain gases can alter the dielectric constant of the material, which in turn changes the capacitance between the metal electrodes.
Reference	*MEMS & Microsystems book by Tai-Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s- utozyZLXkldBGQ6Eh85S*
Module/Topic	Material in Engineering applications 2.4 (Materials for MEMS and Microsystems)

Field	Details
Question	**Which type of polymers are used create patterns on substrates by photo-lithography in MEMS applications?**
Options	A. Ferro-electric polymer
	B. Langmuir-Blodgett (LB) films
	C. Photoresist polymer
	D. Conductive polymers
Correct Answer	**C. Photoresist polymer**
Explanation	Photoresist polymers are special formulated materials designed to produce patterns on substrates through photolithography. Photoresists are applied on the substrates and exposed to light in specified areas that are then developed to show the desired patterns.
Reference	MEMS & Microsystems Design and Manufacture by *Tai- Ran-Hsu* *https://drive.google.com/drive/folders/1pFOW1dUfj4s-utozyZLXkldBGQ6Eh85S*
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