Southwest Center for Microsystems Education (SCME)
University of New Mexico

MEMS: Making Micro Machines Learning Module

This Learning Module supports the film by Silicon Run Productions:

The film introduces MEMS (microelectromechanical systems), applications, fabrication, and design. This learning module provides activities to encourage you to delve deeper into the topics introduced in the film and to demonstrate your understanding of the terminology and general concepts of MEMS.

Target audiences: High School, Community College, University

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Website: www.scme-nm.org

Knowledge Probe (Pre-Quiz)

Introduction

This learning module supports the film MEMS: Making Micro Machines produced and directed by Ruth Carranza of Silicon Run Production. The film introduces MEMS (microelectromechanical systems), applications, fabrication, and design. This learning module provides activities to encourage you to delve deeper into the topics introduced in the film and to demonstrate your understanding of the terminology and general concepts of MEMS.

Before you begin viewing the film, you should complete this Knowledge Probe (KP). The purpose of this KP is to determine your current knowledge of MEMS, MEMS applications, fabrication, packaging and design. You are not expected to know all of the answers to the questions, but you should answer them to the best of your knowledge.

There are twenty (20) questions.

1. MEMS is an acronym for
    a. Micro Energy Manufacturing Systems
    b. Microelectromechanical Systems
    c. Microelectronics Memory Systems
    d. Micro Electron Machines and Semiconductors
    e. Many Engineers Making Stuff

2. MEMS are tiny micromachines that can consist of several types of components. Which of the following types of components would you find in a MEMS?
    a. Mechanical
    b. Electrical
    c. Optical
    d. Fluidic
    e. All of the above could be found in MEMS

3. MEMS inertial sensors sense change in which of the following?
    a. Acceleration
    b. Pressure
    c. Rotation
    d. Color
    e. a and c

4. The MEMS device used to trigger airbag deployment is a(n)
    a. Pressure Sensor
    b. Actuator
    c. Gyroscope
    d. Accelerometer
    e. Light Meter

5. Which of the following components is used in a MEMS pressure sensor to sense changes in pressure, for example blood pressure or tire pressure?
    a. Proof mass
    b. Membrane
    c. Gyroscope
    d. Moveable mirror
    e. a and c

6. Digital Mirror Devices are used in which of the following applications?
    a. Digital projectors
    b. Medical imaging equipment
    c. Computer Monitors
    d. Data communication networks

7. MEMS incorporate microfluidic structures in which of the following applications?
    a. Inertial Sensors
    b. Digital Mirror Devices
    c. Inkjet print heads
    d. Blood Pressure Monitors
    e. b and c

8. In a thermal inkjet print head, which of the following pushes the ink from the micronozzle after the resistive heater is turned on?
    a. Convection Cycle
    b. Microdroplet
    c. Bubble
    d. Powder
    e. Pixel

9. What is the optical MEMS device that consists of an array of millions of micromirrors?
    a. Digital Mirror Device (DMD)
    b. Millions of Mirrors Device (MMD)
    c. Digital Pixel Device (DPD)
    d. Mirror Array (MA)
    e. None of the above

10. What type of MEMS components move other MEMS devices such as micromirrors?
    a. Pressure Sensors
    b. Actuators
    c. Gyroscopes
    d. Accelerometers
    e. Yokes

11. Which of the following MEMS fabrication process steps transfers a pattern into a light sensitive film on the wafer's surface?
    a. Etch
    b. Photolithography
    c. Chemical vapor deposition
    d. Sputtering
    e. Deep Reactive Ion Etch (DRIE)

12. Which of the following MEMS fabrication process steps is used to remove unwanted material from a thin film on the surface of the wafer or from within the wafer substrate?
    a. Etch
    b. Photolithography
    c. Chemical vapor deposition
    d. Sputtering

13. Much of the technology used to fabricate microelectronics (e.g., CMOS chips) can be applied to making MEMS devices.
    a. True
    b. False

14. In MEMS fabrication what is the layer called that provides spacing between two or more moving components by first being deposited and then later removed?
    a. Structural layer
    b. Conductive layer
    c. Sacrificial layer
    d. Masking layer
    e. Insulating layer

15. Which of the following fluidic properties allows a liquid to refill a microchannel without the use of valves or pumps?
    a. Stiction
    b. Torsion
    c. Energy transfer
    d. Capillary action
    e. Laminar flow

16. Which of the following is an advantage of the micronozzles in an inkjet print head being less than 100 microns?
    a. A higher viscosity of ink
    b. Greater print resolution (more pixels)
    c. Minimal turbulence in the flow of the ink
    d. Self-filling microchannels (no need for a mechanical pump)
    e. b and d

17. In the game Guitar Hero, accelerometers measure the movement of the guitar by measuring a change in which of the following electrical characteristics of the accelerometer?
    a. resistance
    b. inductance
    c. voltage
    d. capacitance
    e. electromagnetic

18. Which of the following personnel is NOT needed as a member of the design team for a new MEMS device?
    a. Mechanical engineer
    b. Electrical engineer
    c. Marketing personnel
    d. Systems engineer
    e. All of the above are needed as members of the design team

19. Before a MEMS device is sent to manufacturing, a model of the design must be constructed and tested to ensure that the design meets the customer requirements and specifications.
    a. True
    b. False
    c. Most of the time, but not always

20. Which of the following macro-sized devices is LEAST likely to be redesigned to micro size due to impracticality?
    a. A rotary motor
    b. Hydraulic pump
    c. A gear drive
    d. Stadium Lights
    e. A syringe

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