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# Microcantilevers Final Assessment

## Participant Guide

### Introduction

The purpose of this assessment is to determine your understanding of cantilevers after having completed the Microcantilevers Learning Module.

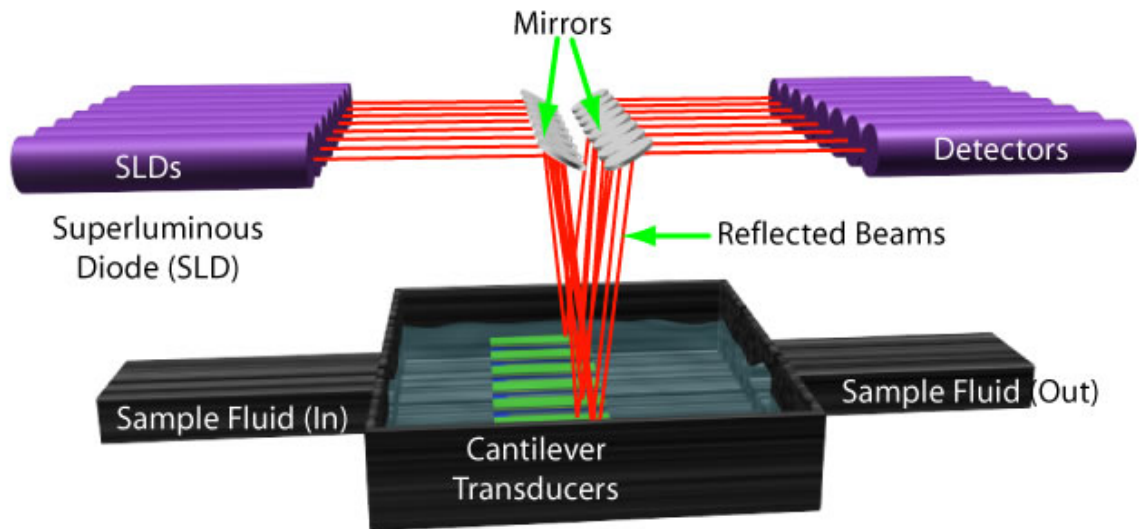
There are 15 questions.

1. What is a cantilever?
  - a. A device used to apply torque to an object (e.g., wrench, screwdriver)
  - b. A type of beam that is constrained at both ends but able to flex in the middle.
  - c. A type of beam constrained at one end and suspended freely at the other end.
  - d. A device used to measure micro-size contaminants
2. Which of the following is NOT a cantilever?
  - a. Jet's wing
  - b. Balcony
  - c. Diving board
  - d. Bridge
3. Which of the following MEMS would be LEAST likely to use a micro-sized cantilever as a sensing or transducing component?
  - a. Airbag actuating sensor
  - b. Ammonia detector
  - c. Virus detector
  - d. Neural probe
4. Which of the following materials has the highest E value (based on Young's Modulus of Elasticity)?
  - a. Glass
  - b. Plastic
  - c. Wood
  - d. Diamond

5. Given four cantilevers of the same material, length and width but different thicknesses – which thickness would provide the highest flexibility?
  - a. 0.5 microns
  - b. 1 micron
  - c. 3 microns
  - d. 5 microns
  
6. What is the relationship between a microcantilever's spring constant ( $k$ ) and its resonant frequency?
  - a. The higher the " $k$ ", the higher the resonant frequency for the same mass.
  - b. The higher the " $k$ ", the lower the resonant frequency for the same mass.
  - c. Spring constant ( $k$ ) has no effect on the microcantilever's resonant frequency
  
7. What does CSA stand for?
  - a. Cantilever Sensor Array
  - b. Chemical Sensor Array
  - c. Cantilever Static Applications
  - d. Cantilever Systems Array
  
8. Which of the following cantilever properties is measured in the dynamic mode of operation?
  - a. Angular deflection
  - b. Resistance
  - c. Resonant Frequency
  - d. Flexibility
  
9. What type of thin film material is used as a strain gauge in cantilevers operating in the static mode?
  - a. Crystalline
  - b. Piezoresistive
  - c. piezoelectric
  - d. thermodynamic
  
10. Which of the following would NOT affect the movement of a microcantilever?
  - a. Electrostatic force
  - b. Mass
  - c. Gravity
  - d. Heat

11. Which mass would yield the lowest resonant frequency of a microcantilever with a 60 micron length, 3 micron thickness, and 10 micron width?
- 10 grams
  - 20 grams
  - 30 grams
  - 40 grams
12. The static mode of microcantilever operation measures the cantilever's \_\_\_\_\_.
- Resonant frequency
  - Mass
  - Displacement
  - Reflectivity
13. Microcantilevers used in CSAs undergo a surface stress which causes a stress-induced curvature of the cantilever. This surface stress is caused by \_\_\_\_\_.
- Chemisorption of analytes on or within the surface.
  - An increase in mass on the cantilevers's surfaces.
  - An increase in weight on the cantilevers' surfacesx
  - The force of analytes hitting the cantilevers' surfaces.
14. Which of the following BEST explains the mechanical stress that causes microcantilever transducers to bend up or down?
- Added mass due to the analytes collecting on the surface, causing the microcantilever to be weighted down
  - Chemical reactions between the analytes and the surface molecules causing the surface layer material to contract or expand
  - Different coefficients of thermal expansion in the top layers of the microcantilevers causing the layers to expand or contract differently.

15. Which of the following BEST describes the CSA in the image below? This type of CSA is commonly used in liquid environments.
- d. Dynamic mode of operation, measures angular deflection
  - e. Static mode of operation, measures angular deflection
  - f. Dynamic mode of operation, measure light intensity
  - g. Static mode of operation, measures light intensity



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