

S-69.3104 Electronic sensors

Exam August 23, 2010 / HS, AV

1. Many of the mechanical sensors include a cantilever beam. Explain by cross-section drawings how this kind of structure is made using sacrificial etching technique (explain each step separately). (10 p)
2. The following figure shows you a cross-section of the P-I-N photodiode.
 - a) Explain the operation principle. (5p)
 - b) What are the benefits of the P-I-N sensor compared to simple pn photodiode? (5p)

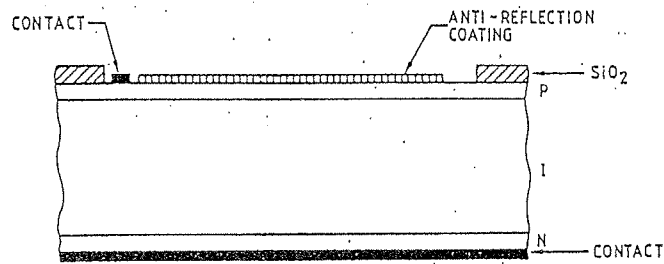


Fig. 2.22 P-I-N photodiode.

3. Design a sensor that can measure position (picture and operation principle). (10p)
4. Piezoresistive effect is utilized in many mechanical sensors.
 - a) Explain the effect (2p)
 - b) Why is piezoresistivity smaller in metals than in semiconductors? (2p)
 - c) What is the doping concentration and temperature dependence of the effect? (2p)
 - d) Give an example of the sensor that utilizes the piezoresistive effect? Explain briefly how. (4p)
5.
 - a) What does Seebeck effect mean? (2p)
 - b) How does Seebeck effect differ in metals and in semiconductors? (2p)
 - c) How can you measure Seebeck effect in silicon (give an example with picture + explanation)?
6. MOS capacitors and MOSFETs can be used as chemical sensors in various ways.
 - a) How the structures of these devices need to be changed in order them to work as chemical sensors (give at least 2 alternatives)? (4p)
 - b) What are the chemical and physical processes that cause these sensors to respond to chemical signals? (3p)
 - c) How the responses of these sensors are measured electrically? (3 p)