國 立 清 華 大 學 命 題 紙

97學年度奈米工程與微系統研究所（所）＿＿＿＿＿＿組碩士班入學考試

科目英 文 科目代碼1802 共7頁第1頁 *請在【答案卷卡】內作答

Part I. Multiple-Choice Selections: (There are 18 problems in Part I. You are to choose the best answer, marked A, B, C, and sometime D, to each question and mark your answer. You get 3 points for each correct answer and -1 point for each wrong answer. Minus points will not be carried over to Part II. You can get between 0 to 54 points in Part I.)

1. By the late 1980's, researchers _1._____ ((A) already developed, (B) have already developed, (C) had already developed) several kinds of electrostatic microactuators.

2. Microstructures can be suspended _2._____ ((A) because (B) because of (C) since) the final removal of sacrificial layers.

3. -5. The experimental setup for the microactuator characterization _3._____ ((A) is (B) was (C) has been) shown in Fig. 10. The bias voltage _4._____ ((A) is (B)was (C)has been) set at 30 volts. A signal generator _5._____ ((A) is (B) was (C)has been) used to drive the input electrode.

6. Bio MEMS _6._____ ((A)is (B)are (C)has been (D)have been) a very active research area since the early 1990's.

7. The stiffness of the spring 1 is greater than _7._____ ((A)spring 2 (B) that of spring 2 (C) which of spring 2).

8. -9. Polycrystalline silicon is a material commonly used in integrated electronic circuit _8._____ ((A); however, (B) , and (C) , but also) its process-dependant residual stress _9._____ ((A) make (B) making (C) makes) its adoption for MEMS device supplications challenging.

10.-11. Global warming does _10_____ ((A) has (B)have (C) had) serious effects _11._____ ((A) with (B)to (C)on (D)in) our earth and our future.

12. The experimental tasks were divided _12._____ ((A) between (B)among (C)into (D)before) the five project team members.

13. My explanation of the "EWOD" phenomenon is quite different from _13.____ ((A)you (B)your (C)yours).

14. The micro mirror is made of _14._____ ((A)a metal (B) metal (C) one metal).

15.-16. The _15._____ ((A) observed (B) observing (C) observes (D) observe) phenomenon is thought of as _16._____ ((A) requiring (B) requires (C) required (D) require) further study.

17.-18. In a biomedical science _17._____ ((A) as (B) such as (C) for example) cell biology, significance often _18._____ ((A) refer (B)refers (C) referred) directly to health-related problems.

Part II. Writing and Reading Comprehension: (There are 14 problems including 10 multiple-choice problems and 4 fill-in problems in Part II. You are to choose the best answer, marked A, B, C, and sometime D, to each multiple-choice question and mark your answer. You get 3 points for each correct multiple-choice answer and -1 point for each wrong answer. You get 4 points for each correct answer to fill-in problems. You can get between 0 to 46 points in Part II.)

19.-21. The importance of expectations in experimental design cannot be over-emphasized. Every investigator has in mind certain hypotheses about the experimental system under study. These hypotheses will determine the investigator's expectations, and many of these hypotheses are taken for granted and never made _19._____ ((A) implicit (B) explicit (C) explosive). Critical to the ability of investigators to design good experiments is their understanding that hypotheses determine not only the expected results _20._____ ((A)

as well as (B) but also (C) and) the possible results that can be obtained. Otherwise, one is in the position of the marine biologist who, after 21._____ ((A) study (B) studied (C) studying) deep-sea life using a net with two-inch mesh, concluded that there were no fish smaller than two inches in the sea.

22._____ "The importance of expectations in experimental design cannot be over-emphasized" means

(A) We should not over-emphasize the importance of it.
(B) We might emphasize the importance of it a little bit too much.
(C) The expectations in experimental design are very important.
(D) We should exaggerate the importance of it.

23. _____ The marine biologist's conclusion that there were no fish smaller than two inches in the sea is wrong because

(A) he didn't understand hypothesis determined expected results.
(B) he didn't understand the size of mesh determined the possible results.
(C) he didn't know there were fishes smaller than two inches.
(D) he fished in the wrong place.

Answer problems 24-32 base on the following excerpts of a conference paper.

nanowires and nanotubes can be achieved in silicon and these new technologies are compatible with the thermal budget of CMOS. As shown in Fig. 2, this new fabrication technique is to grow the nanowires between two specially shaped microstructures.

3. HANDHELD PORTABLE ELECTRONICS

The market for handheld and portable electronics is being governed by a simple, three-part technology roadmap. The first component of the roadmap is 1) to shrink the current size and power required for the operation of the wireless link. The next component of the roadmap is 2) to increase the level of functionality of the handheld portable electronic by adding new RF channels (television, FM radio, wireless links) and/or new sensor capability (magnetic compass, microaccelerometers, micro chemical sensors) to differentiate the handheld from its competitors in the market. The final component is 3) to provide the handheld with the ability to form a self-assembling network with its environs and provide unprecedented usefulness to the human who possesses the handheld.

For this revolution to continue, the size and number of the components currently found in a handheld portable (for example, a cell phone) must decrease. In Fig. 3 is shown an older-generation cell phone circuit board. This board is covered with a large number of passive components that drive up the cost, power and size of the cell phone.

New fabrication methods in MEMS and nano technology, as well as new device designs can assist in the compression of the circuits of the handheld portable electronic device. MEMS resonators both in polysilicon and in aluminum nitride, as well as new nanostructures can be used to 1) reduce the overall size of the passive components, 2) reduce the number of passive components required and 3) reduce the total die size required on silicon ships by fabricating the new devices *directly on top* of the silicon CMOS circuits. As shown in Fig. 4 below, new MEMS technology for aluminum nitride piezoelectric resonators can be made totally compatible with CMOS fabrication. These resonators can be used for high-*Q* filter networks.

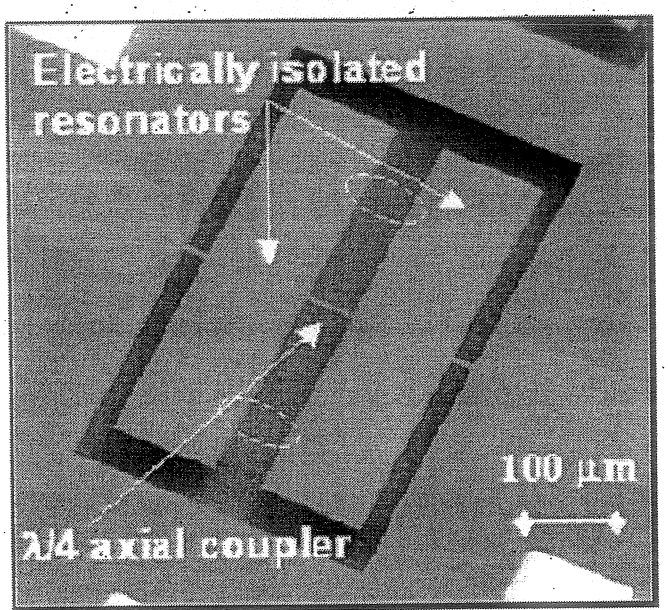

Fig. 4. Two Aluminum Nitride MEMS resonators in series. These two resonators are connected mechanically by a thin, 2µm axial coupler set to a length of one-quarter wavelength to maximize the efficiency of energy transfer from one resonator to another. The RF signal is introduced to one resonator, changed from

electrical to mechanical energy, transmitted to the second resonator as mechanical energy, and then converted to electrical energy for subsequent processing by CMOS electronic circuits.

4. AUTOMOTIVE SENSORS

The field of automotive sensors has been dominated by vigorous cost reduction and reliability enhancement. However, the time appears right for new technologies in MEMS and nano to introduce new functionality into the automotive sensor market. As shown in Fig. 5, there is a growing need for new kinds of sensors that require extremely low power and possess wireless RF communication. In the example shown, a new MEMS force sensor is attached to

24.-25. _____ mechanical coupler was used in serial MEMS resonator linkage to maximize the efficiency of _____.

26._____ According to this paper, the field of automotive sensors has been dominated by (A) vicious cost reduction (B) wonderful cost reduction (C) reliability improvement (D) size reduction.

27.-28. There is growing need for new automotive sensors that require _27._____ and possess _____.

29._____ The market of handheld and portable electronics is not being governed by (A) size reduction (B) power reduction (C) increasing functionality (D) increasing usable life.

30._____ To make nano-device fabrication compatible to CMOS thermal budget, carbon nano tubes are fabricated at what temperature in the example given in the paper: (A) high temperature (B) room temperature (C) freezing temperature (D) temperature is not relevant.

31.＿＿＿＿ The total die size can be reduced by (A) fabricating the MEMS devices right next to CMOS circuits (B) fabricating the MEMS devices on a separate die with additional bonding pads (C) fabricating the MEMS devices directly on top of the CMOS circuits.

32.＿＿＿＿ According to the paper, for the MEMS resonators used for high-Q filter networks, the energy is transferred from one resonator to the following resonator (A) electrically (B) mechanically (C) optically.