

2010年8月26日実施

2011年度立命館大学大学院理工学研究科  
博士課程後期課程  
入学試験問題（外国語科目）

電気電子・光型

【注意事項】

1. 解答は問題番号1、2、・・・ごとに解答用紙1枚を使用して下さい。
2. 受験番号、氏名、問題番号を解答用紙すべてに記入して下さい。
3. 無記名答案は無効、問題用紙および解答用紙の持ち帰りは認めていません。
4. 解答用紙はホッチキス止めしてあるので、はずさないで下さい。
5. 問題用紙が事前に届け出ている型の問題であるか確認し、解答して下さい。
6. 外国語科目試験時間  
10:00～11:30（90分）  
試験時間中の途中退室は認めていません。

## 立命館大学大学院理工学研究科（博士課程後期課程）

### [外国語] 電気電子・光型

1. 次の英文を読んで、設問に答えよ。

Through all the decades of microchip evolution one thing has remained constant: the silicon transistors of which they're made are basically flat. But that is very likely to change in the next five years. The semiconductor industry is facing a problem that can be solved only with a fundamental transistor redesign. Transistors are no longer the clean on-off switches they once were; instead, current leaks through them even when they are supposed to be off. As transistors shrink with each new generation of microchip, this errant current increases, draining batteries and heating chips up. ...

Going from flat to three-dimensional in the conservative microchip industry is a radical shift, but as Leo Mathew, a research scientist at Freescale Semiconductor, says, "the payoff will be substantial."

The semiconductor industry has fed the consumer appetite for better electronics performance by shrinking the transistors' structure to cram more of them onto chip. ... Normally, you can picture a transistor in four parts, the source and drain, connected by a channel and topped off by a gate. Most of the transistor is in one plane, built into the silicon substrate of the microchip. Only the gate and its extremely thin insulating layer, which lie directly above the channel, protrude slightly above the flat plane of silicon. Voltage on the gate causes a conductive path to form in the channel, allowing current to flow between the source and the drain.

However, shrinking this structure further means that removing the voltage on the gate no longer completely stops the flow of electrons. Even in today's transistors the source and drain are separated by mere tens of nanometers, a short enough distance for electrons to leak through the lower part of the channel, farthest from the gate. The result is wasted power and heat. ①It's one reason the battery power on an unplugged laptop seems to evaporate quickly and why companies have to spend huge sums to cool their server rooms. Realizing that source-drain leakage will only get worse as chips shrink, researchers have sought to plug the leak by raising the channel, source, and drain out of the substrate. ②The gate is then draped over the channel on three sides like a lower-case "n". Now the current is constrained only to the raised channel, and electrons no longer have a path through which to leak. This general class of transistor is called multigate, because the wrapped gate is like having three gates instead of one. But ③"the shift to multigate transistors requires a fundamental change in transistor design," says John Pellerin, director of logic technology development at Advanced Micro Devices. That's because to make multiple gates, nearly everyone agrees you have to go vertical. According to Infineon Technologies' principle scientist for CMOS devices Klaus Schrüfer, multigate technology is a game changer: "Multigate is the only device architecture for scaling" into the foreseeable future, he says.

出典: S. Adee, "Transistors Go Vertical," IEEE Spectrum, pp. 13-14, Nov. 2007.

- (1) 下線部①に述べられている現象の理由を、文中から読み取り日本語で説明せよ。
- (2) 波線部②で述べられている内容について、日本語で説明せよ（図等を用いても良い）。
- (3) 破線部③で述べられている発言の理由を、文中から読み取り日本語で説明せよ。
- (4) "Multigate"が、半導体企業とエンドユーザに及ぼす影響について、本文に即して論じよ。

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2.

次の文を読んで日本語で要約しなさい。