FIRST, part 2

EXTRA FIRST AND IELTS READING PRACTICE

You are going to read an online article on how chips are made. Six sentences have been removed from the article. Choose from the sentences A-G the one which fits each gap (1-6). There is one extra sentence which you do not need to use.

Semiconductor Manufacturing: How a Chip is Made

The semiconductor chip is well recognised today for the fundamental revolution it brought to the advancement of electronics technology. Since the first integrated circuit was created by Jack Kilby in Texas Instruments labs more than 50 years ago, the idea of transistors on silicon becoming the building blocks for intelligent processors has transformed almost every facet of daily life. Even though chips are widely used, how the transformation of simple sand (silicon) into a highly complex chip occurs, is less widely known. **1.** .....

From Sand to Ingots

The semiconductor manufacturing process begins with one of the most common elements on earth, silicon. Silicon is found in abundance in sand, but before it is used in semiconductor manufacturing it is refined to be virtually 100% pure. **2.** .....

Pure silicon is then heated until it reaches a molten state and a perfectly structured silicon "seed" is then lowered into the molten silicon. The chemical properties of the molten silicon allow a chemical bond to be formed with the seed and a long ingot of solid silicon can slowly be pulled from the silicon as its cools and solidifies around the seed. **3.** .....

The ingot is then carefully sawed into thin wafers the diameter of the ingot, most commonly 200 mm (8-inches) or 300 mm (12-inches) across.

Into the Fab

TI buys its wafers from companies that specialise in manufacturing the silicon ingots. **4.** ..... Silicon is the base material for chips precisely because of the conductive properties related to its molecular structure. Under certain conditions silicon will conduct electricity and under other conditions it does not. That's why we use the term "semiconductor." This on/off capability is what underlies the transistor switching action that forms the ones and zeros of digital logic.

The multiple steps in semiconductor manufacturing all serve to build components with the necessary electrical structure to rapidly switch and transfer signals for computational purposes. In addition to the switching transistors and the metal traces that conduct electrical signals between various regions of the chips, insulating materials separate conducting areas of the device.

In order to alter the characteristics of the semiconductor, the following steps are undertaken in various sequences depending on the complexity and functionality of the device.

- Deposition is the process by which an insulating layer is grown on the silicon substrate.
- Diffusion bakes impurities into areas of the wafer to alter its electrical characteristics.
- Ion implantation is another process for infusing the silicon with various dopants to change its electrical characteristics

In between these steps, areas of the chip are patterned with an image for that particular layer of the device via photolithography. **5.** ..... This pattern hardens into an exact representation of the mask when it is developed. Etching then removes selective areas of the pattern using a plasma that reacts to the material not covered by the hardened photoresist.

These steps are repeated to create layers of transistors with precise operating characteristics that have been determined by the deposition, diffusion and ion implantation steps. A specialised deposition process called Metallization forms the critical interconnections between different areas of the chip and different transistors. **6.** .....

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After all production steps are complete, a final protective layer is put over the entire wafer. Probe testing then provides an initial look at how many functional devices are on the wafer. (Current technology allows us to pack more than 180,000 transistors in the cross-sectional area of a single human hair.) Next, a very precise saw cuts the individual chips from the wafer and the good die are packaged, tested again and shipped to the customer.
Although the above steps are in general use across the semiconductor industry, proficiency in manufacturing is a vital aspect to success in this highly competitive market.

From: http://www.ti.com/corp/docs/manufacturing/howchipmade.shtml

A. In such tiny dimensions, even the smallest dust particle can ruin the functionality of an entire chip!
B. In photolithography, a very precise "mask" is used to expose photoresist that has been applied across the wafer, much like emulsion on film.
C. Metallization is also used to form the bonding pads that connect the chip to the package and then to the circuit board of the system it supports.
D. Once the bare wafers, or substrates, arrive at TI, our real work begins!
E. Purity of materials is fundamental to delivering chips that function as intended.
F. This short description was developed by Texas Instruments to explain at a high level what takes place in the unique environment where chips are made, the semiconductor fab.
G. When the process is complete, the finished ingot exactly mimics the physical characteristics of the original seed material.

Making silicon wafers.

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