Crystals and microelectronics

Most of the electronic components we use on a daily basis contain near-perfect crystals, more familiarly known as semiconductors.

Panels of light diodes, a multitude of crystals. Source: Night in Kyoto, Japan

LEDs

Light emitting diodes are semiconducting crystals whose structure resembles that of silicon or diamond. Depending on their composition, they produce colours in the visible, infrared or ultraviolet range. Crystals doped with near-perfect GaAsP, GaP and ZnSe will produce red, green and blue respectively.

The current challenge facing optoelectronics, in addition to miniaturization, is to improve the intensity of light emission whilst reducing power consumption, with a view to replacing the incandescent bulbs in traffic lights and advertisements with LEDs. We are also now seeing the emergence of new sources of white light.

The crystal most widely used in electronics is silicon. The silicon crystal has to be near-perfect with just a few impurities added to allow its properties to be adjusted to suit demand (known as «doping» the crystal). The field of microelectronics involves the study and manufacture of these semiconductor micro-components.

From Granddad's transistor radio set to the chips in our computers

Semiconductor crystals now dominate our daily lives; they are found in industrial or domestic robots, smart cards, and computers. And the trend is to integrate these more and more densely, at miniature scales, on to ever tinier surfaces. All this requires the «production» of perfect crystals with very few chemical and structural defects.

Crystals as a source of light

The analogue microcomponents now commonly found in the «fairy lights» on modern Christmas trees are light-emitting diodes produced with near-perfect crystals.

A single crystal silicon bar

To reduce production costs modern electronic circuits are grouped on wafers of larger and larger perfect crystals. These wafers are cut from a huge single silicon crystal in the shape of a bar. The bar grows from the small seed crystal located at the tip of a thin rod and in contact with hot liquid silicon. The small seed crystal grows and grows...

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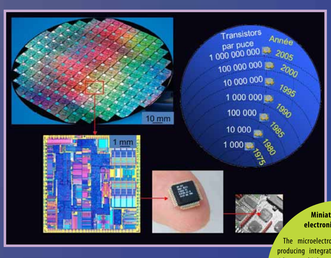

Miniaturization of electronic components

The microelectronics industry is now producing integrated semiconductor chips with ever higher numbers of miniaturised components. The result is increased efficiency. The first transistor radios contained a single transistor, whilst the microprocessors powering today's computers and telephones contain millions.

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