A Step in the Evolution of Integrated Circuit Technology

Denis Nadein

One major bottle-neck of future chip-manufacturing technologies seems to be in the connections between the individual parts within the chip (a.k.a. integrated circuit). This project work has investigated a new way to measure on these connections, in order to make improvements to them easier, with promising results.

For faster and more energy efficient eletronic equipment, such as computers and mobile phones, a successor to the chip manufacturing technology of today must be developed.

A chip usually consists of a huge amount of tiny on/off switches, called transistors. These switches are connected in a systematic way with each other, with an organized way of switching on and off, producing information (like audio or video, for example). If the transistors are able to be switched on and off faster, the whole chip can work faster as well. However, it is not enough to simply have fast individual transistors. The transistors must be connected together somehow, and they must be able to talk to (signal) each other sufficiently fast. The connection is made of various very thin wires and contacts, similarly to the nervous system in the human body. Traditionally, the speed of the on/off signal produced by a transistor was much less than the maximum of what the contacts could handle. Recently, this situation has changed and the transistors have become so efficient that the contacts are becoming a bottle-neck.

Transistor contacts in future technologies may require different ways of testing than traditional ones. This project used a common principle for such testing. The principle is based on placing several similar contacts, at different distances from each other, to find out a parameter of interest which does not change with distance. This information can then be used to decide how good a contact is (meaning, how fast it can let the transistors talk to each other).

The manufacturing work was done in a clean-room - a workspace with a controlled atmosphere, with much smaller amount of dust in the air than a typical office space. This is needed in order to prevent damage that dust particles can inflict on the small and sensitive circuits which are being manufactured there.

This way of testing contacts was done successfully in this work, with results being similar when looking at comparable projects on the subject.

References

[1] Nadein, Denis (2016). Development of Contacts for Vertical GaSb Nanowires using Transmission Line Measurements. Masters Thesis, Lunds University, Sweden.