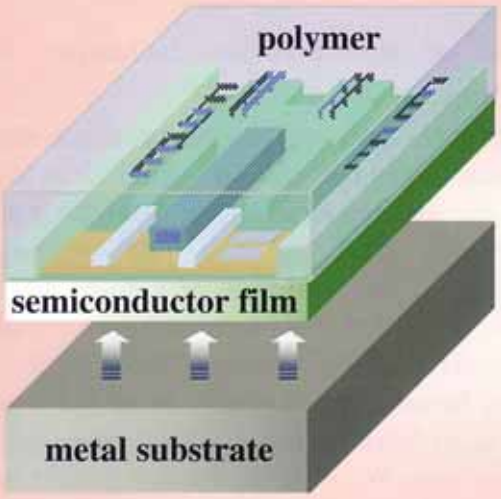
5-Year Project

Semiconductor film transfer process Concept of "flexible devices"

Project Leader

Hiroshi Fujioka



Semiconductor film transfer process

Concept of "flexible devices"

It is well known that today's information-driven society relies heavily upon semiconductor devices such as integrated circuits, light emitting diodes, and lasers. These devices are usually fabricated on single crystalline semiconductor wafers. However, the use of single crystalline wafers imposes serious restrictions on the device area and makes the devices expensive. Recently, we have found that high-quality semiconductor thin films can be grown on metal substrates with large grains using nitride buffer layers. The use of the semiconductor films grown on the metal substrates is advantageous over conventional semiconductor device fabrication processes when they are used for large-area and low-costapplications.

Since metal substrates and semiconductor films show totally different chemical and physical properties, it is quite easy to separate the semiconductor films from the metal substrates, suggesting that we can put large-area semiconductor films on any materials and make all the structural materials intelligent. This technique is especially attractive for transferring the semiconductor films to polymer substrates because the combination of these two materials enables us to fabricate soft and transparent large-area devices at low cost. We believe that this project will open the gateway for flexible devices that are free of the constraints of brittleness, small size, and high cost of semiconductor wafers.

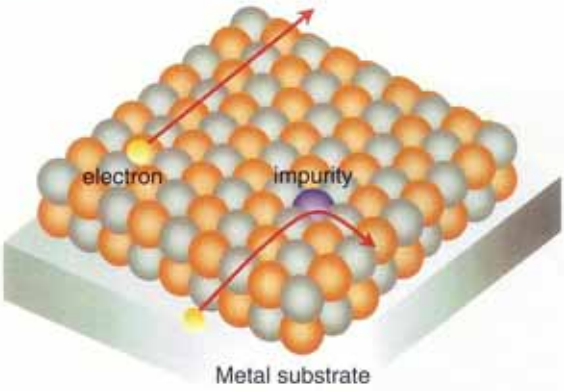


Fig. 1 Electrons traveling in a semiconductor film grown on a metal substrate.

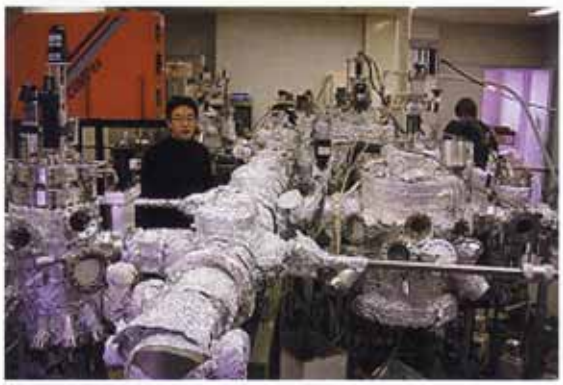


Fig. 2 Multi-chamber MBE system for epitaxial growth of semiconductor films on metal substrates.

●Contents of Research

1) Development of fabrication processes for high-performance devices on metal substrates.

To fabricate high-performance semiconductor devices, electrons must travel at high speed in the crystals. This can be achieved when the atoms that comprise the semiconductor crystals align periodically without impurities as shown in Fig. 1. We will develop a process for growing well-ordered semiconductor films with low impurity concentration on metal substrates using the multi-chamber MBE system shown in Fig. 2. The use of the semiconductor films grown on the metal substrates is advantageous over conventional semiconductor device fabrication processes when they are used for large-area and low-cost applications.

2) Development of the transfer technique for semiconductorfilms.

Since metal substrates and semiconductor films show totally different chemical and physical properties, it is quite easy to separate the semiconductor films from the metal substrates, suggesting that we can put large-area semiconductor films on any materials and make all the structural materials intelligent. This technique is especially attractive for transferring the semiconductor films to polymer substrates because the combination of these two materials enables us to fabricate soft and transparent large-area devices at low cost. We believe that this project will open the gateway for flexible devices that are free of the constraints of brittleness, small size, and high cost of semiconductor wafers.

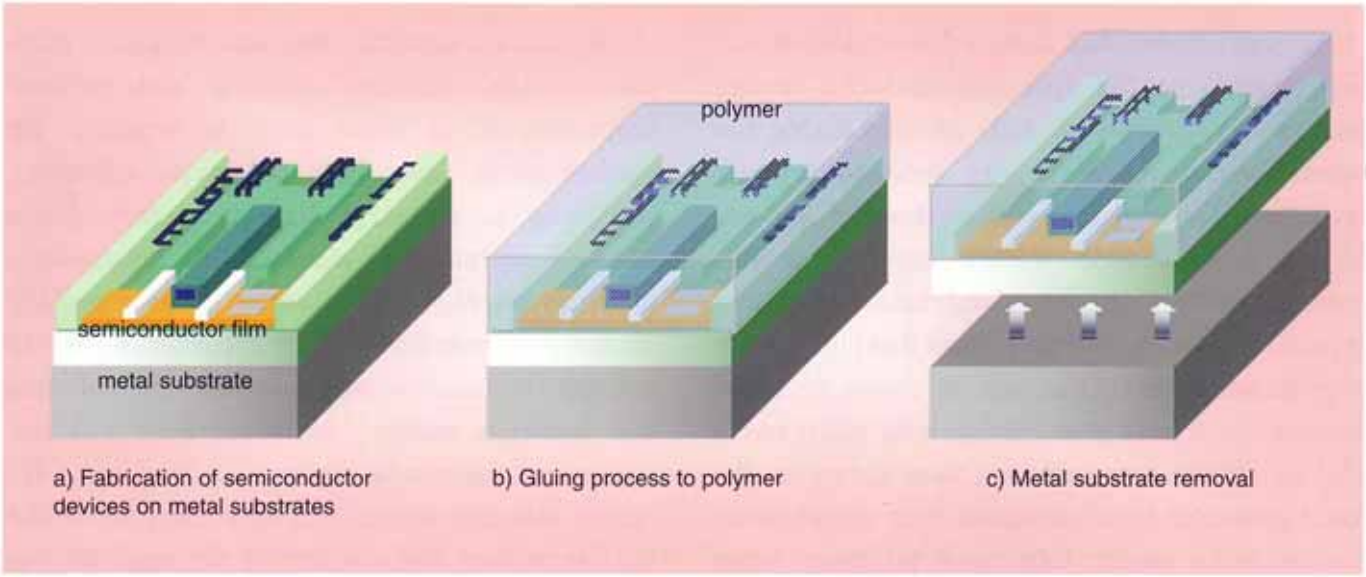


Fig. 3 Schematic illustration of semiconductor film transfer processes.

●Organization of Research

Term: April 2003 to March 2008

Structure: Project Leader, several regular researchers, several part-time researchers, and several collaborative research members from the University of Tokyo

Location: Kanagawa Science Park (KSP) East Building 3rd Floor