RAL

DESIGN & DISCOVERY

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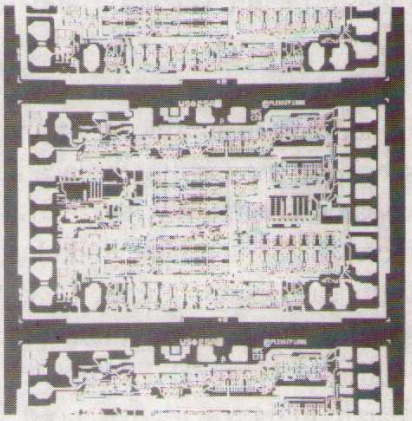
RUTHERFORD APPLETON LABORATORY

SCIENCE AND ENGINEERING RESEARCH COUNCIL

ELECTRON BEAM LITHOGRAPHY UNIT

Modern electronic equipment is made up of a number of microchips which are connected together to perform a certain function. A microchip is a collection of micro-miniaturised transistors, capacitors and resistors. It consists of a number of layers of processed material laid on top of each other, each layer containing parts of circuit elements and/or connection paths.

To manufacture the chip usually involves making a stencil or 'mask' for each layer which is an image of the pattern of the layer used to delineate the features using various chemical, ion-beam and other techniques. 12-16 of these masks are typically required to produce a chip and it is here that the EBLF has traditionally applied its electron-beam techniques.



Portion of a mask showing one typical layer of a silicon chip

As the features are so small, typically 1-2 microns wide, and because each layer of the chip must fit and couple to the ones above and beneath it very accurately, the technological demands are very high. The EBLF has a range of high-precision machines in its ultra-clean suite of rooms. The equipment writes and inspects the masks in virtually dust-free conditions with the minimum of human contact in the process. Cleanliness down to 10 particles/cubic foot is acheived and constantly monitored (a typical 'clean' living area has a particle count of about 1 million/ cubic foot) by air filtering and the use of special clothing to protect the environment from contamination by human debris (dead skin, for example).

To complement the electron beam processing techniques, other advanced methods of patterning are employed, such as Focussed Ion-Beam (FIB) machining, in the production of the special structures that are required for state-of-the-art scientific and technological research.

In addition to its role in providing specialist services to the academic research community, the EBLF is increasingly involved in Industrial and European collaborations. It is the host site for the DTI-supported academic-industrial National Electronics Research Initiative in Advanced Lithography and it is a major player in the Basic Long-term Research programme of the JESSI (Joint European Submicron Silicon) Initiative, a EUREKA programme. The EBLF is also involved in ESPRIT and other CEC programmes and is widely regarded as the leading UK centre for Advanced Lithographic techniques.

For further information on any of the EBLF capabilities, please contact the Head of the EBLF, Professor R A Lawes on 0235 446328.

Operator setting up the 'Chipcheck' inspection machine prior to a defect inspection run

Apart from its microelectronics-oriented work, the EBLF is also active in the field of microengineering. A typical example of this is the design and study of micro-filters for the determination of blood-cell characteristics, for example the stiffness of the cell skin and the viscosity of the liquid inside the cell, work which is important in the study of diabetes. Such micro-precision techniques could contribute significantly to the development of medical and other techniques.