MOTION & DEFORMATION DURING FORMING

- In the forming processes material deformation determined by the relative tool-workpiece motion
- The motion generates the compression stresses in a workpiece
- The developed stresses deform a workpiece

TOOLS MOTION

- Two tools
- One tool moving, the second tool-motionless
- Exception: rolling

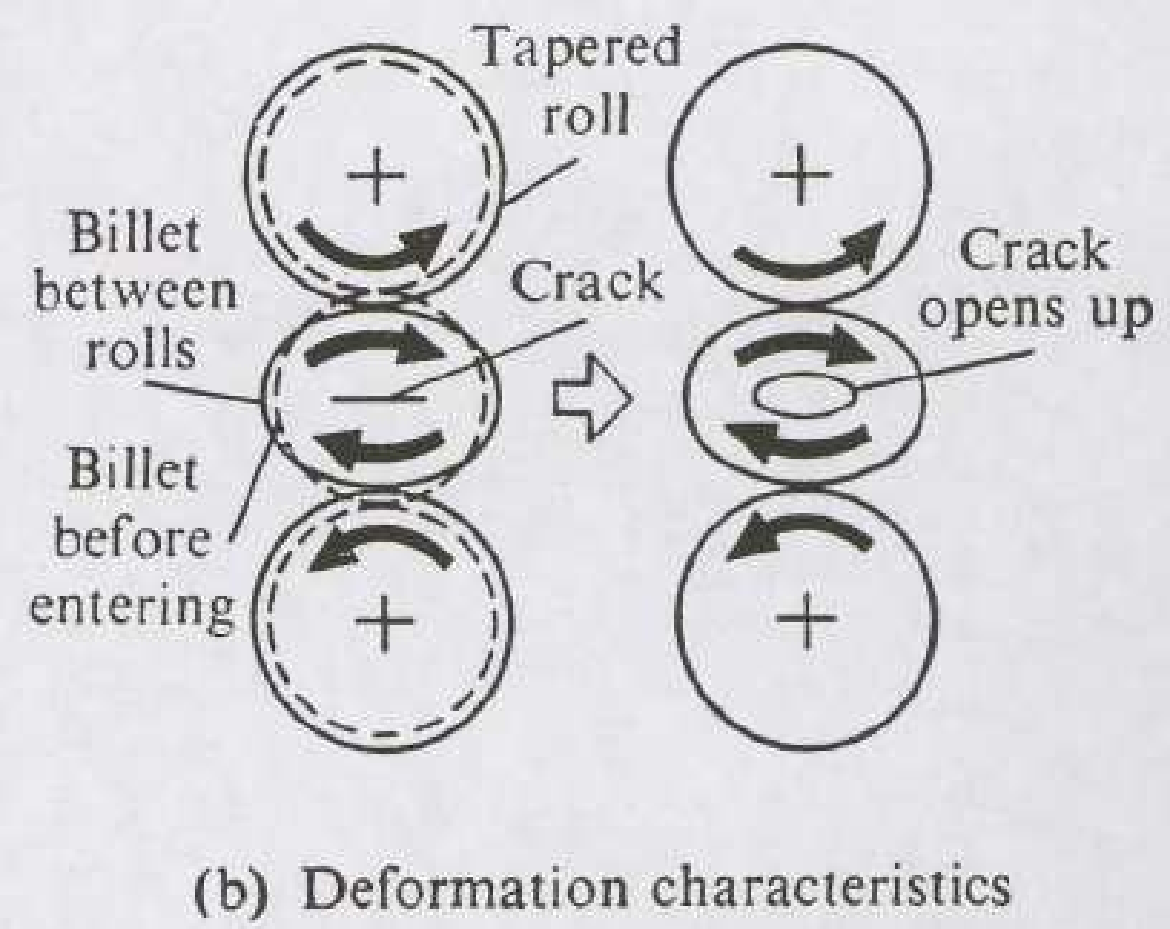
WORKPIECE MOTION

- Motion due to deformation only (forging , blanking, bending)
- A workpiece is moving (extrusion, drawing, rolling)

FORCES EXERTED ON A WORKPIECE

- Impact (forging, blanking, extrusion)
- Pressure at the tool-workpiece boundary (forging, extrusion, drawing)

Principal of tube piercing



HOT WORKING

- Advantages: decrease in the yield strength, increase in ductility, no strain hardening
- Shortcomings: poor tolerances, undesirable reactions, cost of heating

HOT WORKING: TEMPERATURE RANGE

- Lower limit: complete recrystallization
- Maximal temperature: oxidation, grain growth, phase transformation

COLD (ROOM TEMPERATURE) WORKING

- Advantages: superior dimensional control, surface finish, minimal contamination, no heating, strain hardening
- Shortcomings: high forces, lower ductility,

HIGH ENERGY RATE FORMING

- Underwater Explosion
- Underwater Spark discharge
- Pneumatic-mechanical means
- Fast combustion
- Magnetic field

FLUID TOOLS

- Hydro forming
- Explosive forming

LAUNCHER

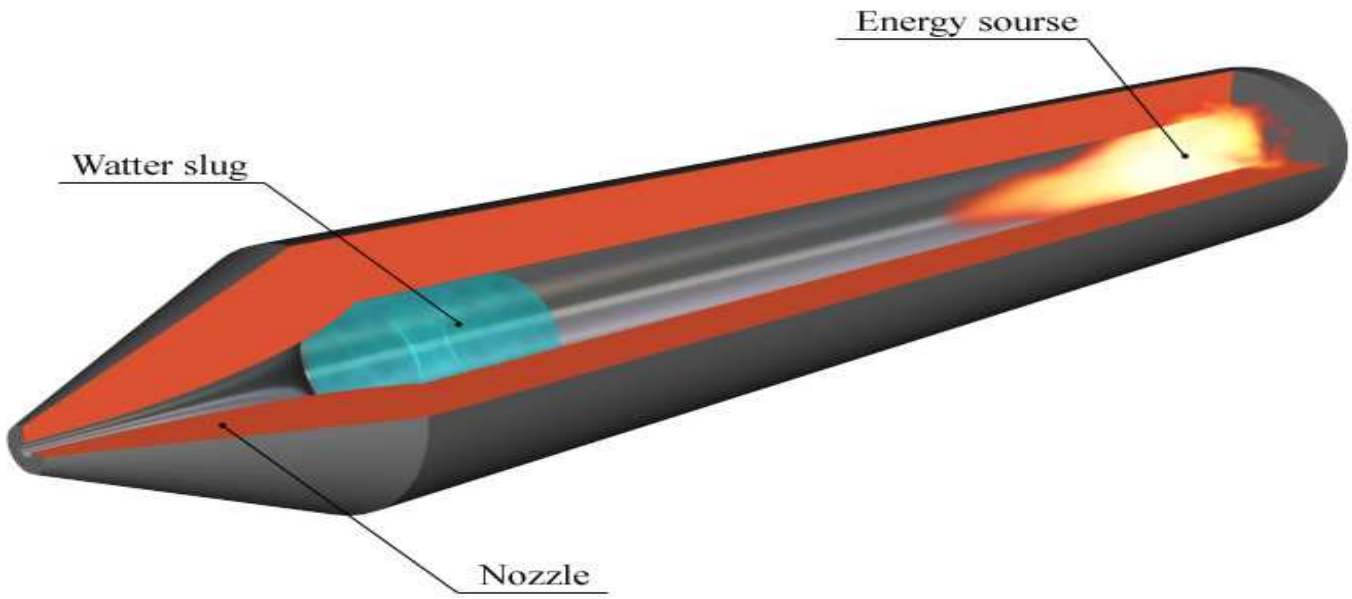


Figure 1. Schematic a launcher, water is driven by combustion products.

PRECISION FORMING

Figure 13. General view of a coin stamped on aluminum and cooper samples. Notice reproduction of fine details of the coin on the sample surface.

MICROFORMING

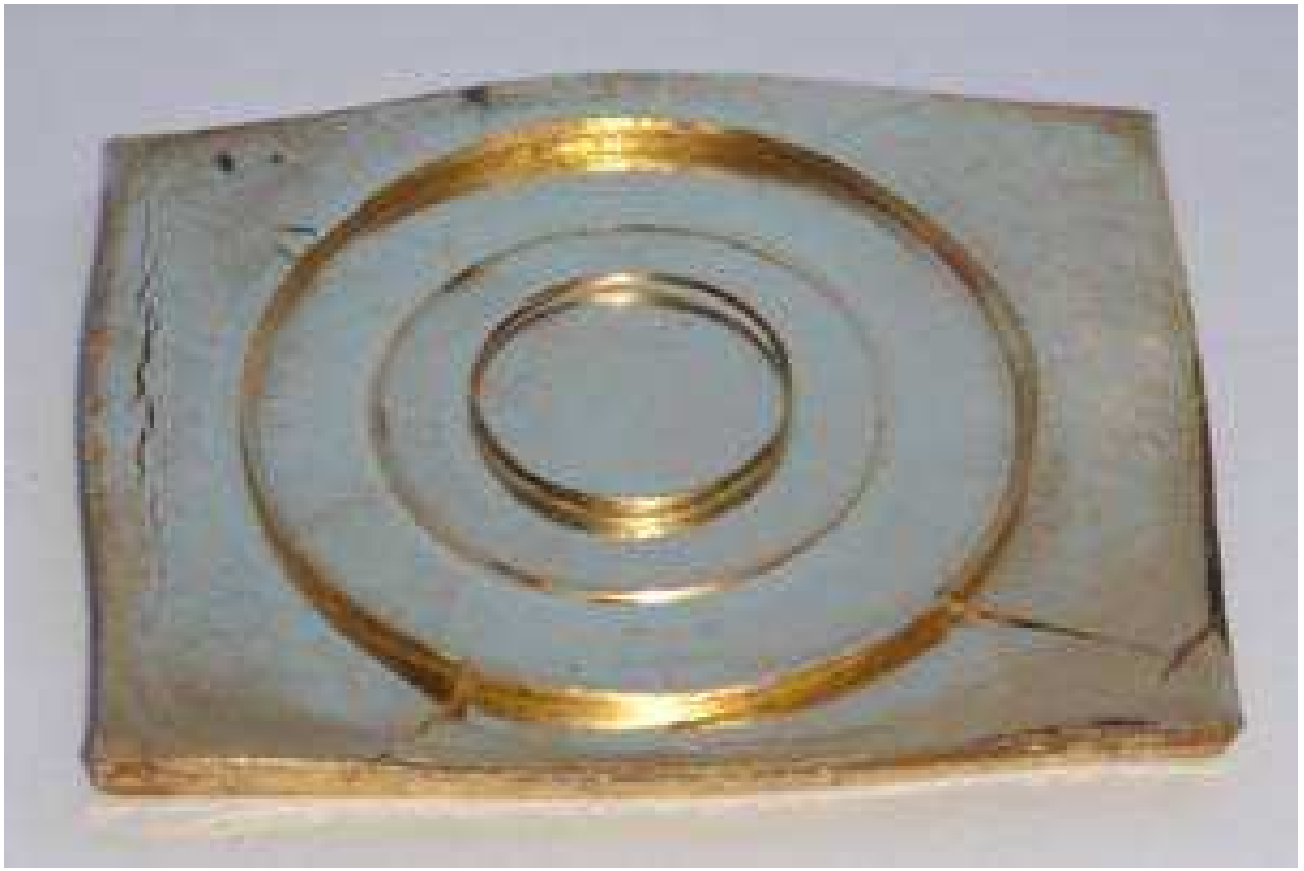


Figure14. Extruded circular brass rings

ELECTRONIC MANUFACTURING

•An **integrated circuit** (**IC**, **microcircuit**, **microchip**, **silicon chip**, or **chip**) is a miniaturized electronic circuit manufactured on the surface of a thin substrate of semiconductor material.

PRODUCTION OF IC

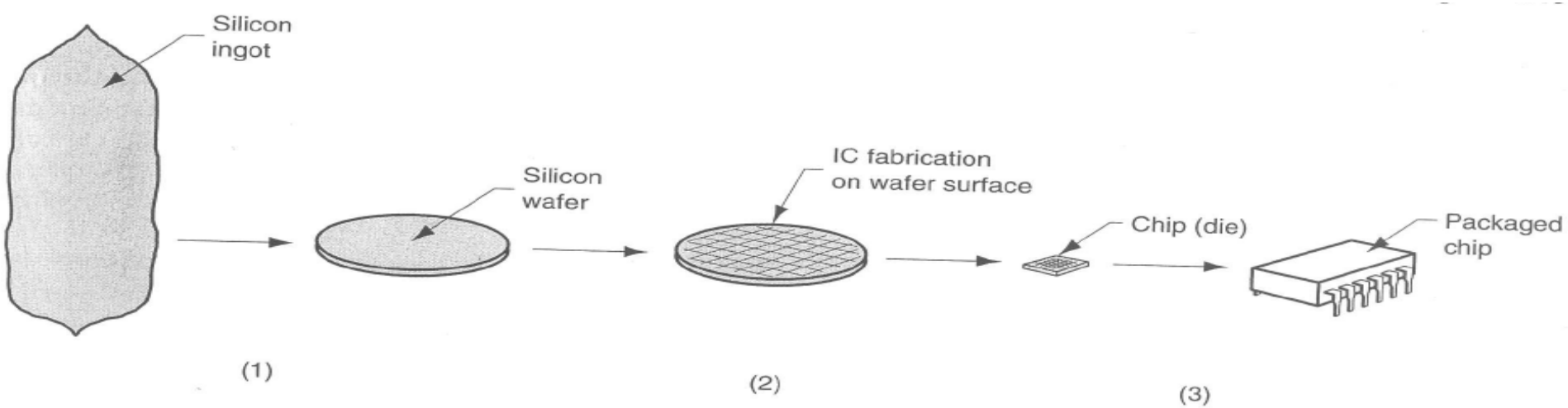
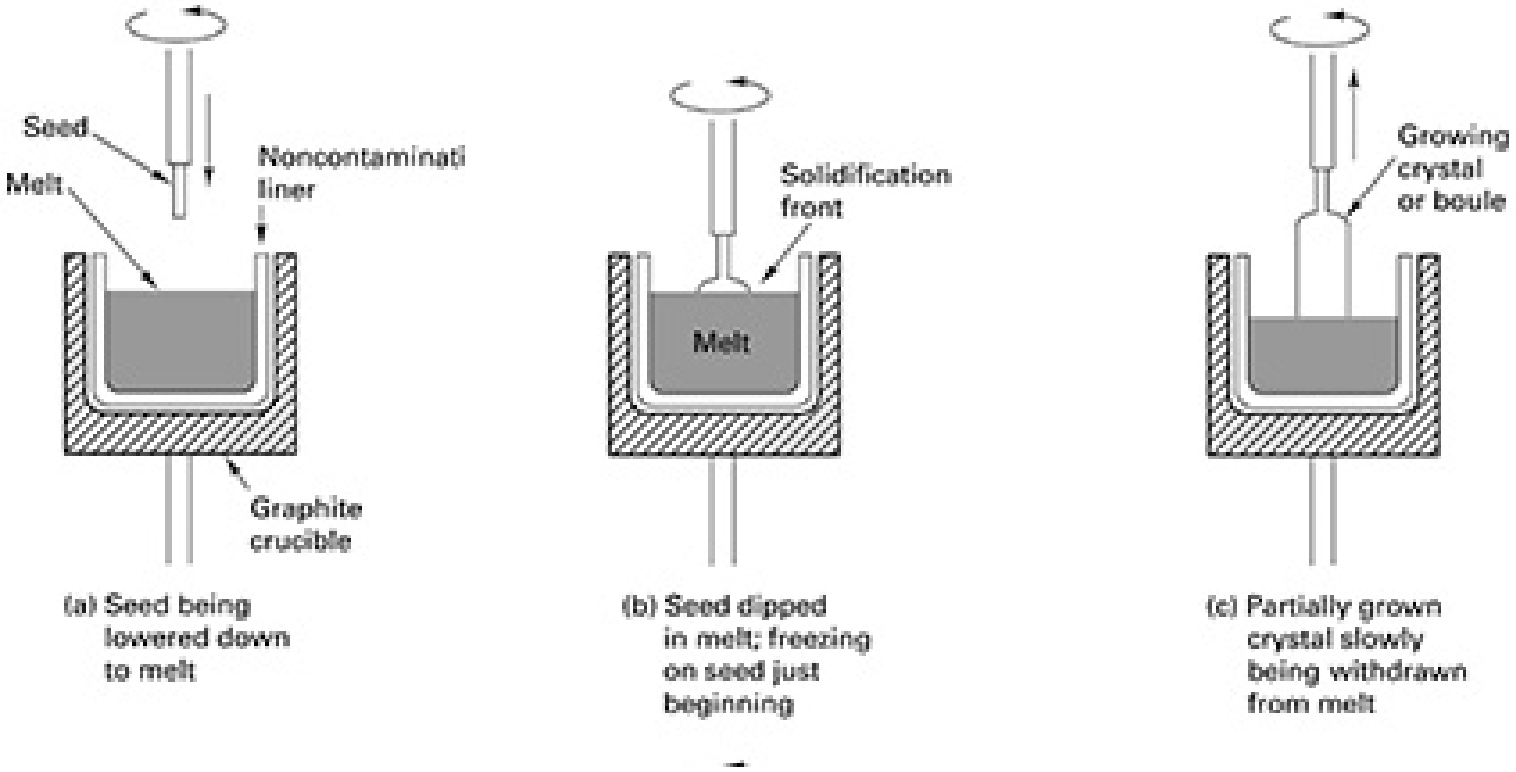
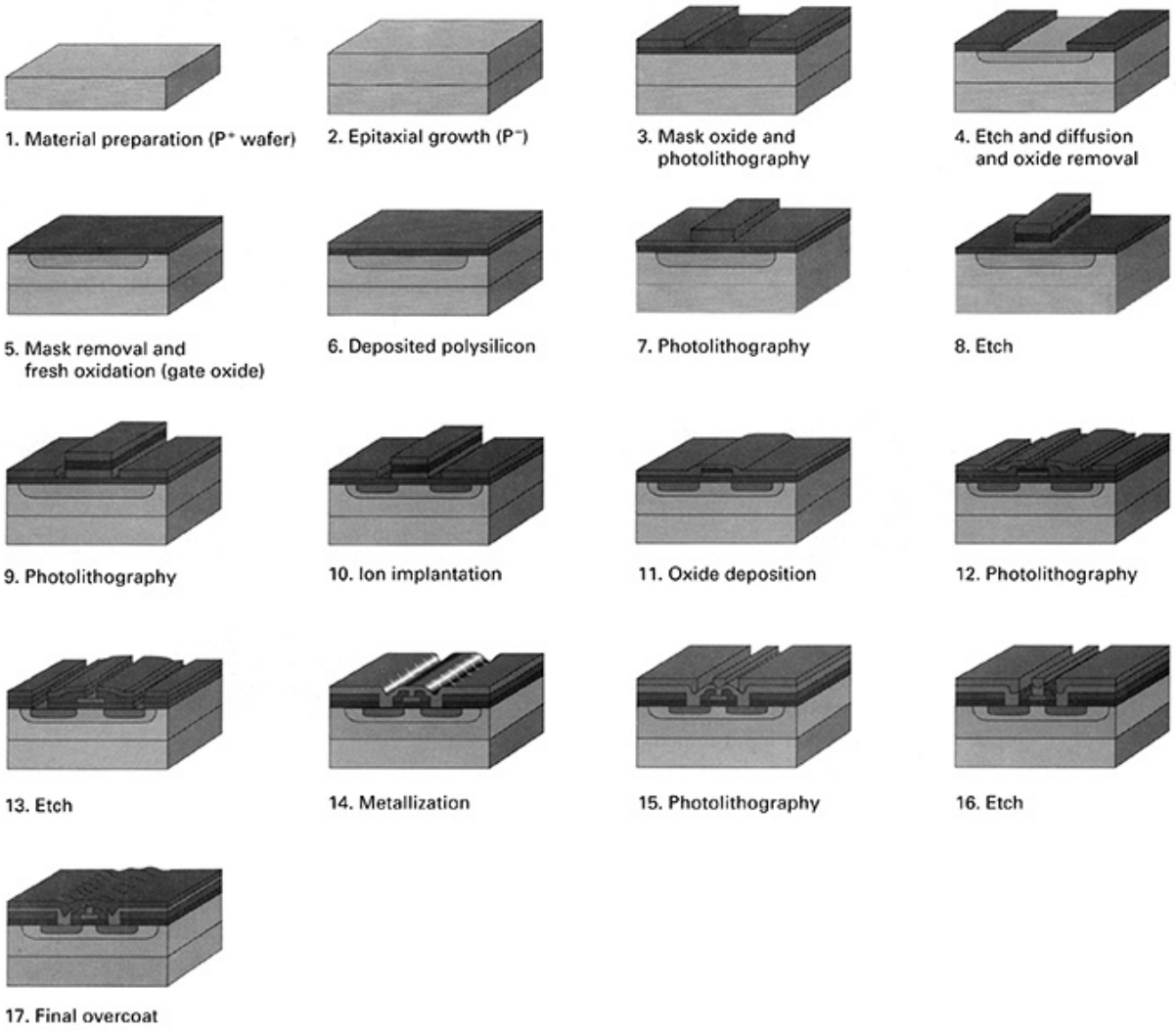


FIGURE 34.3 Sequence of processing steps in the production of integrated circuits: (1) pure silicon is formed from the molten state into an ingot and then sliced into wafers, (2) fabrication of integrated circuits on the wafer surface, and (3) wafer is cut into chips and packaged.

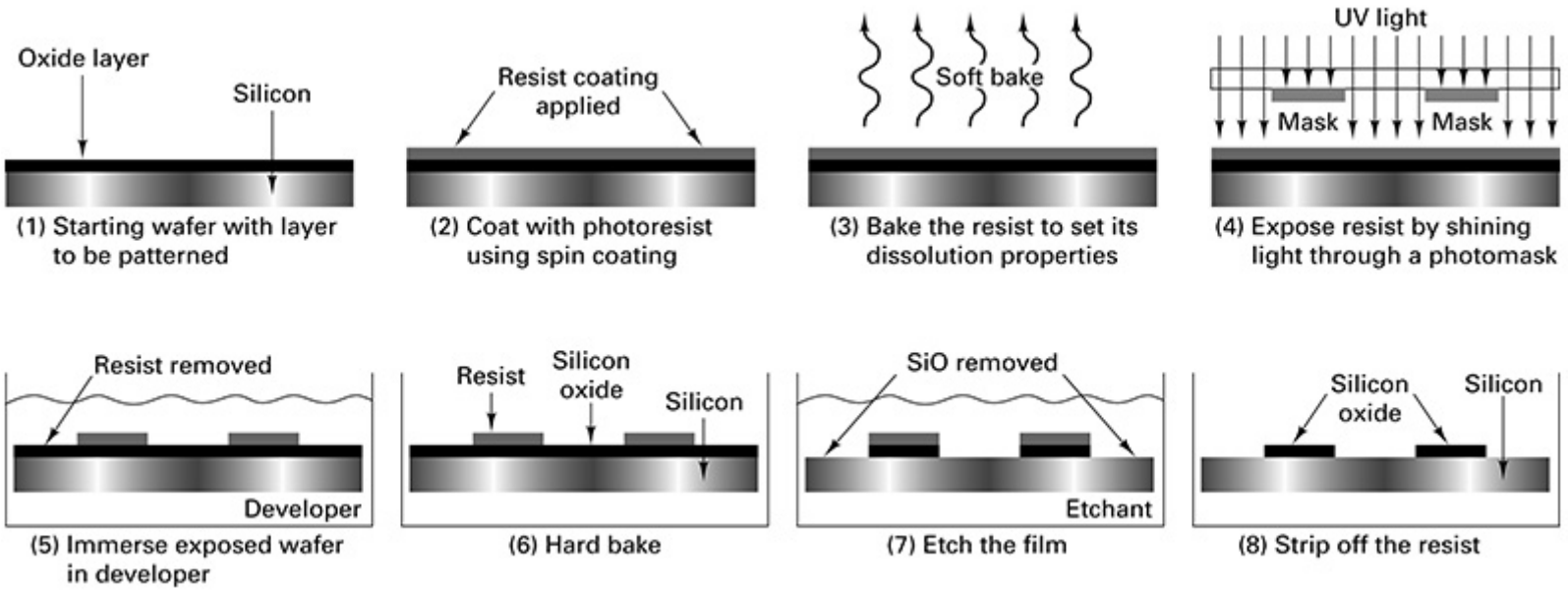
Silicon Production



MOS-Fabrication



Photolythography Process



UNIT PROCESSES
RESULT IN CHANGES OF

- Chemical composition
- Phase composition
- Structure
- Shape
- Mass
- Density

MATERIAL PROCESSING FAMILY