Manufacturing Process SMJP 2113

Advanced Machining Operation

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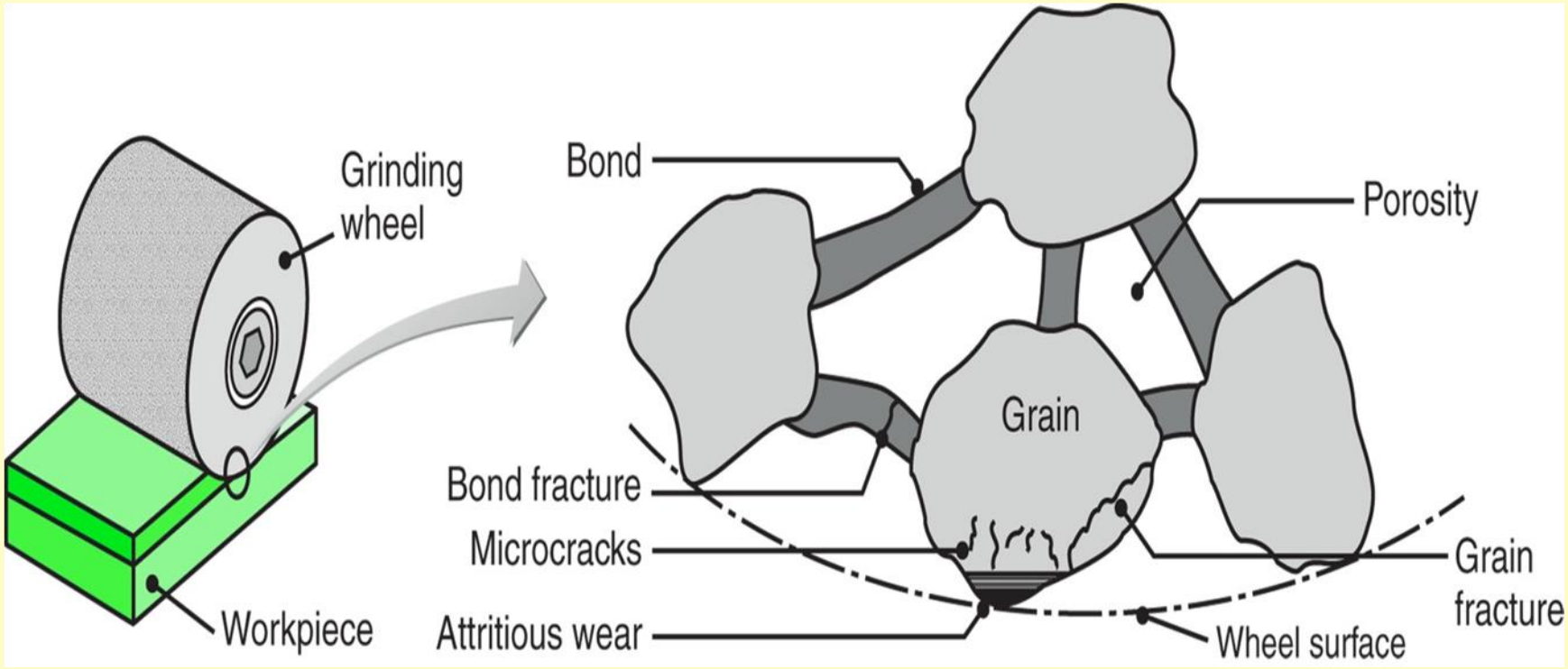
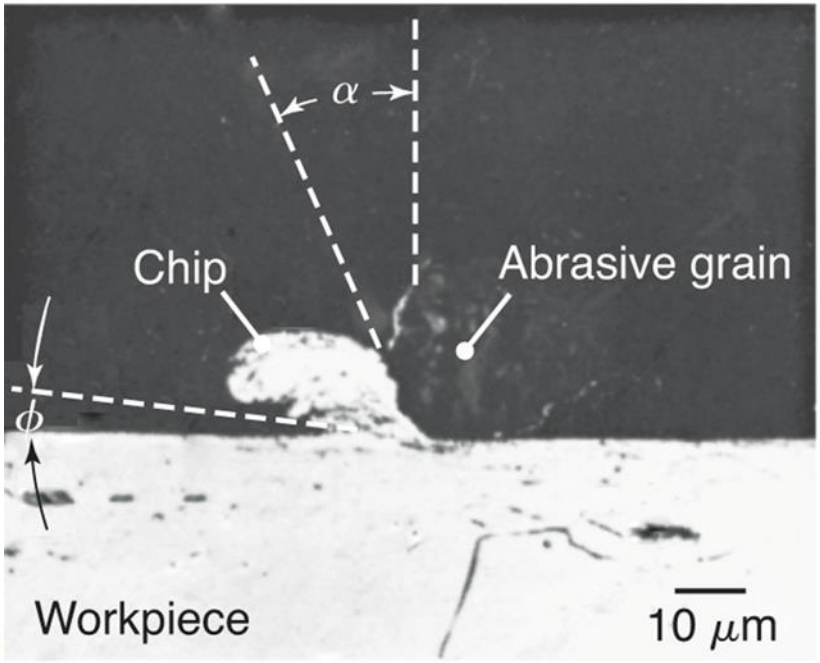
Abrasive Machining

- The final steps in the production of parts
- Capability to impart high dimensional accuracy and surface finish
- Conventional abrasive and Super abrasive
- Typical parts Ball and roller bearing , piston ring , valve cam, gears , tools and dies

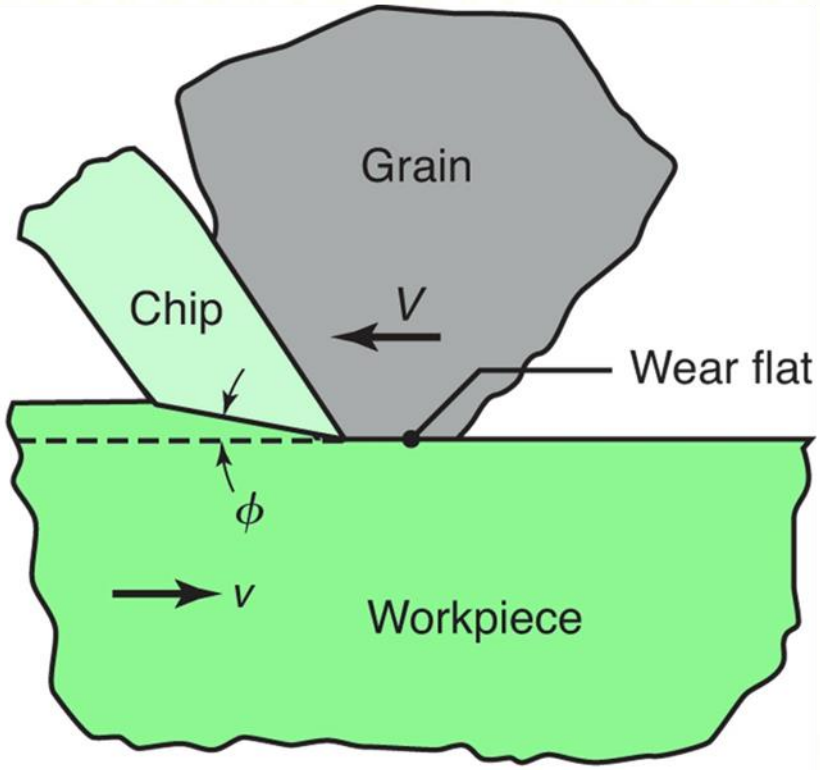
Schematic illustration of a physical model of a grinding wheel, showing its structure and its wear and fracture patterns.



(a) Grinding chip being produced by a single abrasive grain. Note the large negative rake angle of the grain. The inscribed circle is 0.065 mm (0.0025 in.) in diameter. (b) Schematic illustration of chip formation by an abrasive grain with a wear flat. Note the negative rake angle of the grain and the small shear angle.

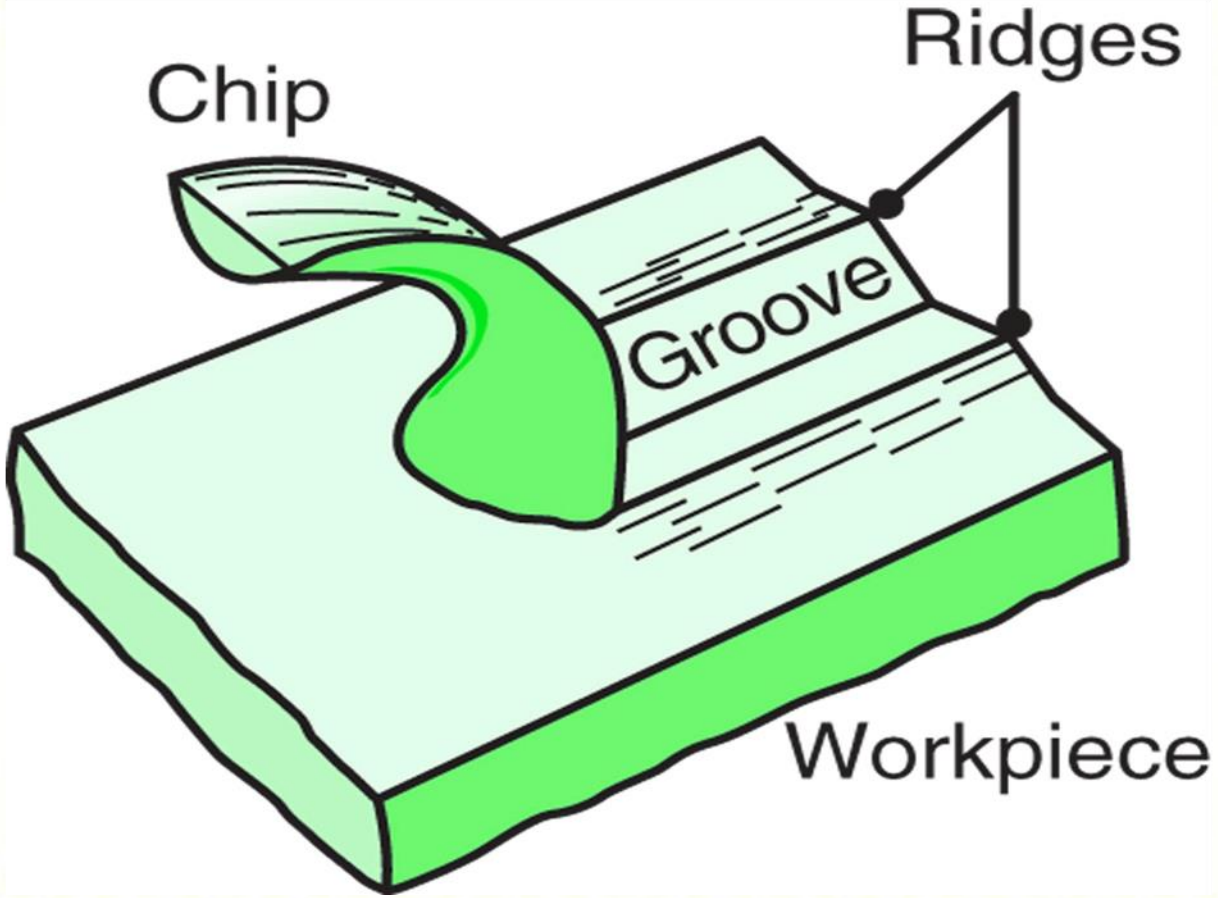


(a)

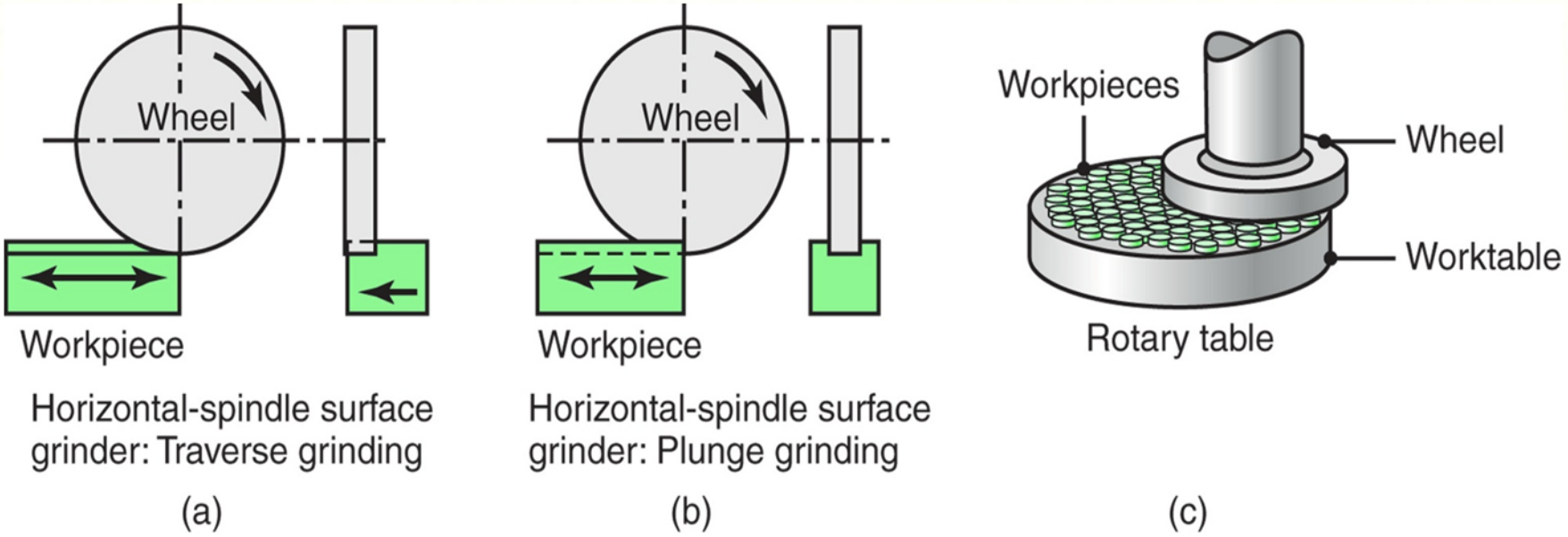


(b)

Chip formation and plowing of the work piece surface by an abrasive grain

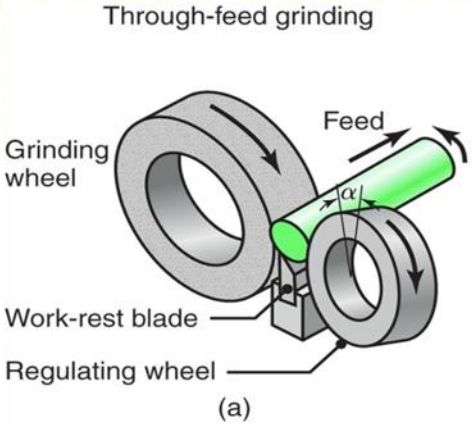


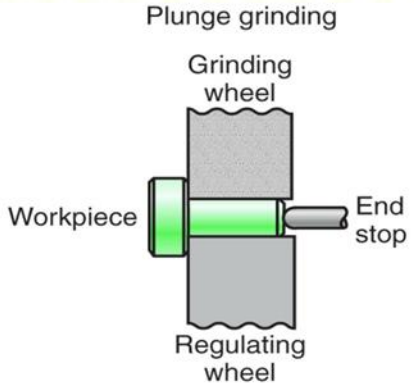
Schematic illustrations of various surface-grinding operations

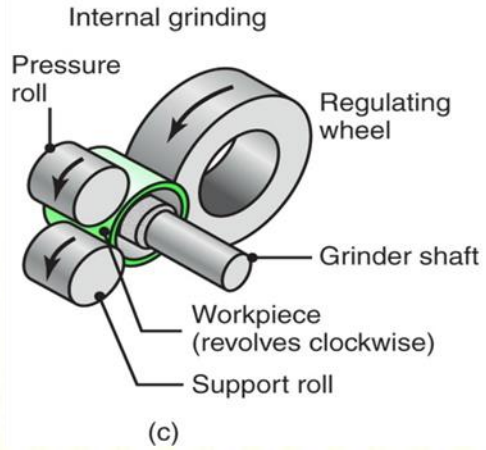


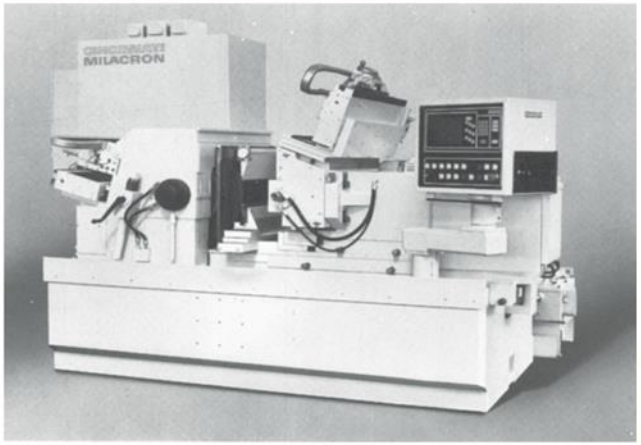
(a) Traverse grinding with a horizontal-spindle surface grinder. (b) Plunge grinding with a horizontal spindle surface grinder, producing a groove in the work piece. (c) A vertical-spindle rotary table grinder (also known as the *Blanchard* type).

Schematic illustrations of center less grinding operations: (a) through-feed grinding, (b) plunge grinding, (c) and internal grinding; (d) a computer numerical-control cylindrical-grinding machine.

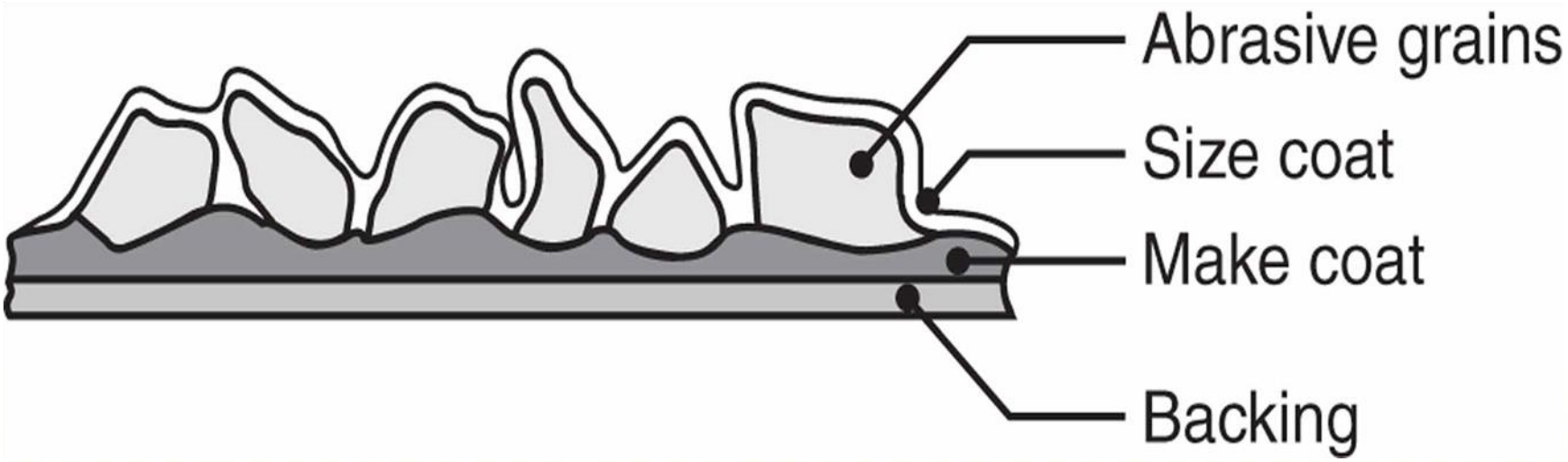




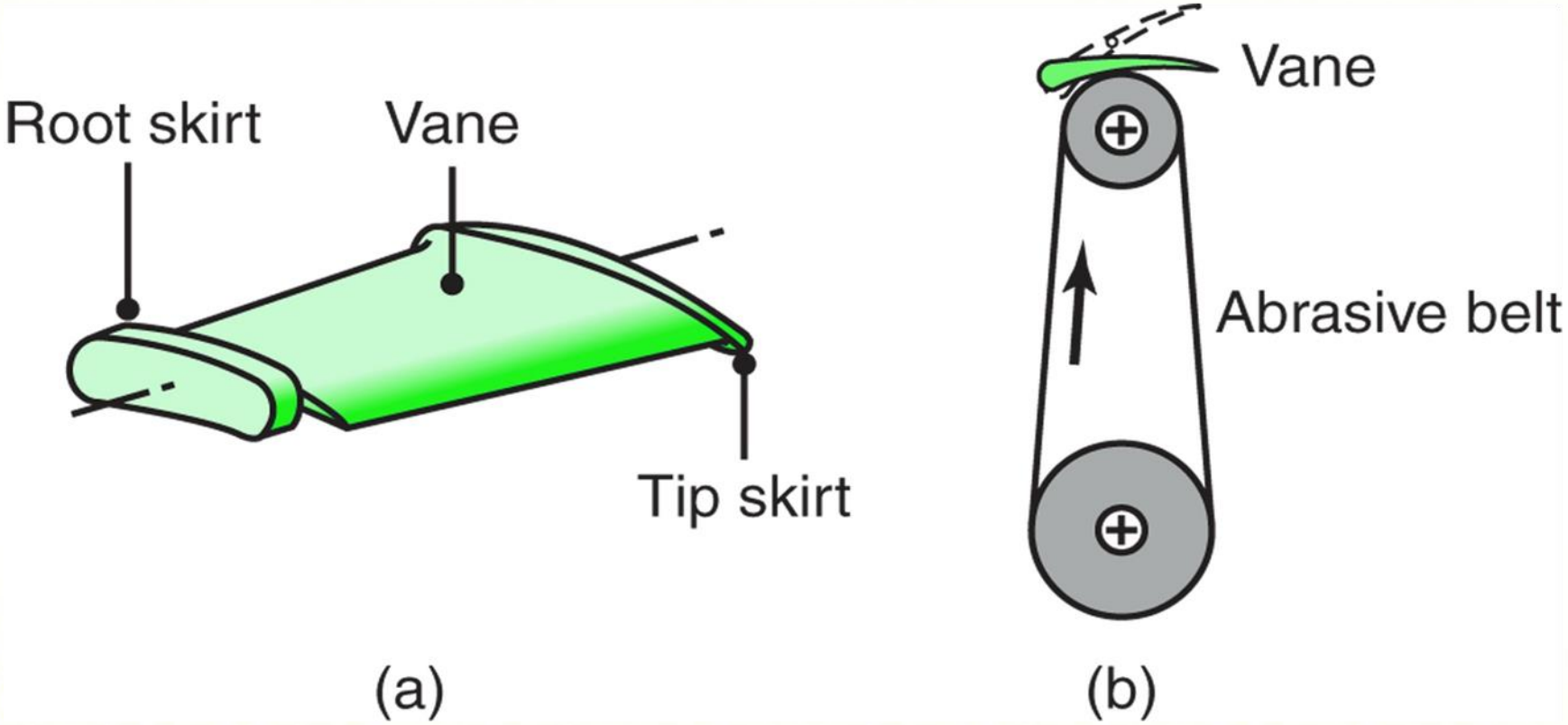




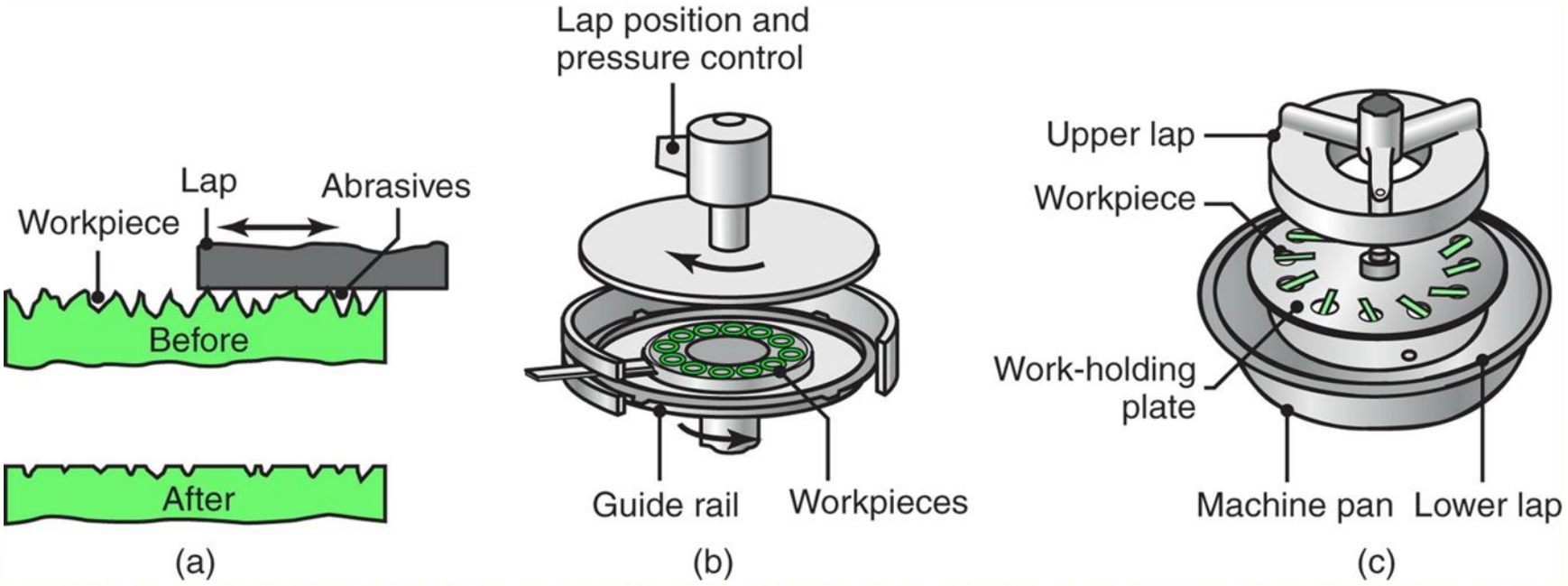
Schematic illustration of the structure of a coated abrasive. Sandpaper (developed in the 16th century) and emery cloth are common examples of coated abrasives.



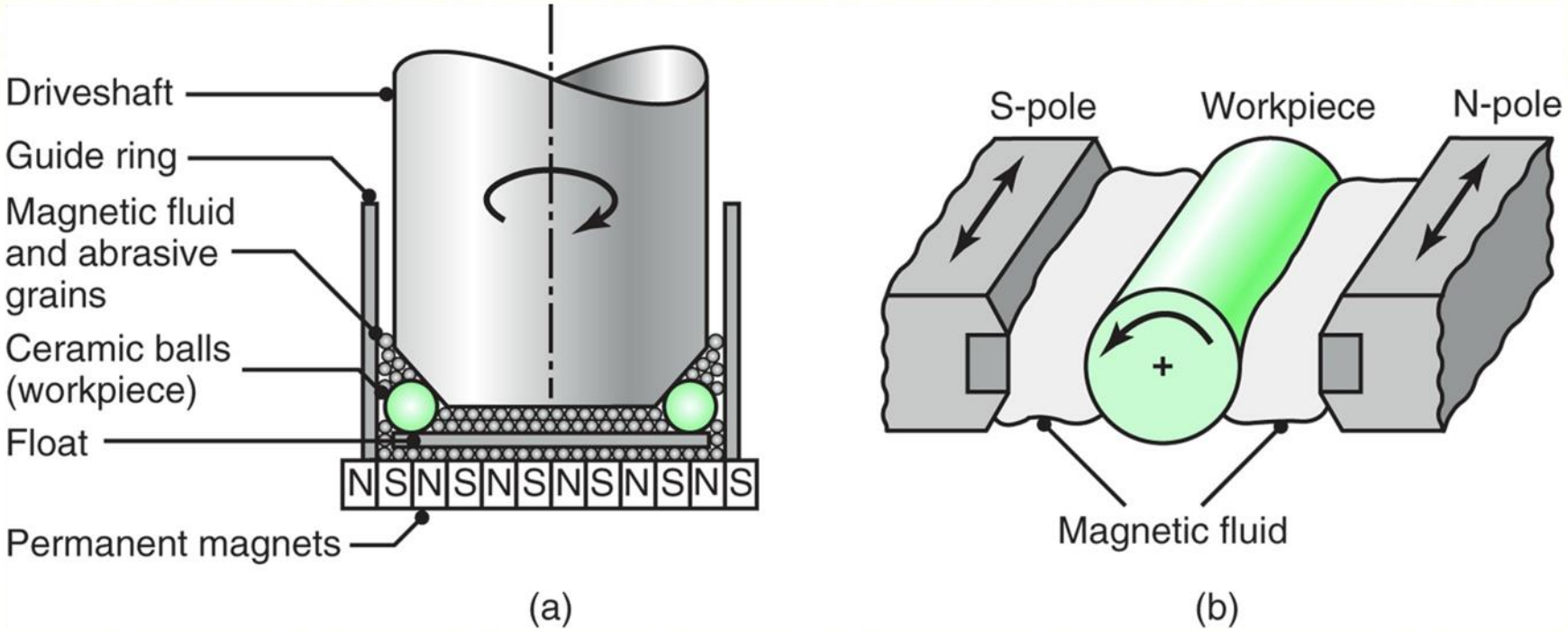
Belt Grinding of Turbine Nozzle Vane



(a) Schematic illustration of the lapping process.
(b) Production lapping on flat surfaces.
(c) Production lapping on cylindrical surfaces.

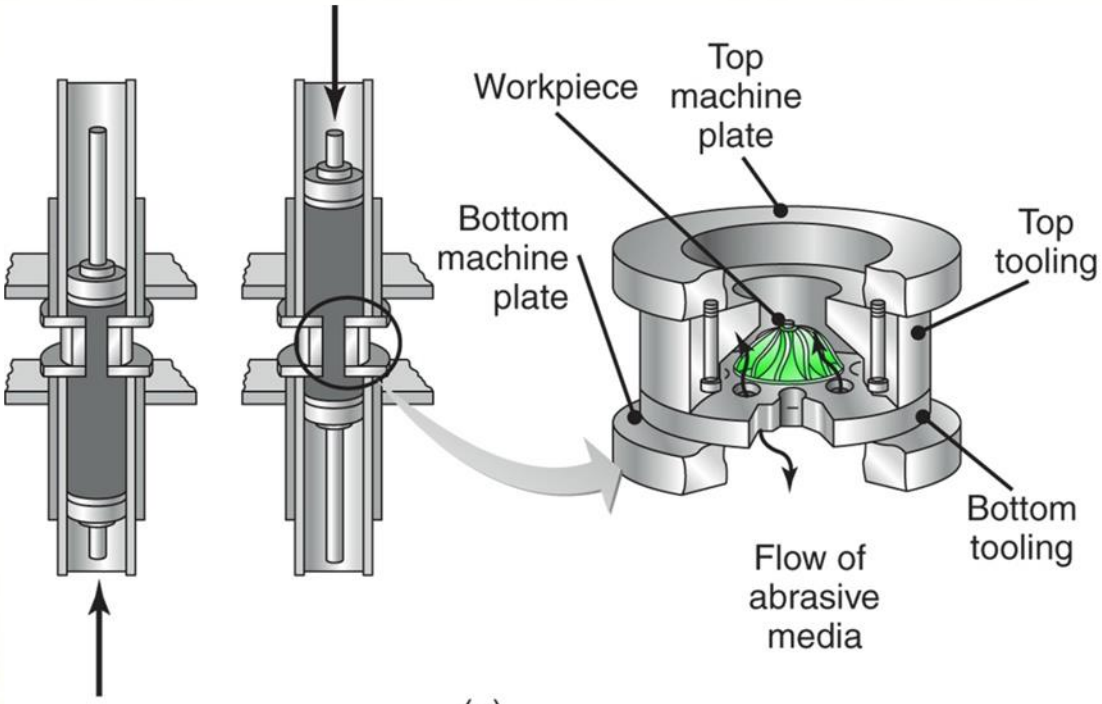


Schematic illustration of polishing of balls and rollers by magnetic fields



(a) Magnetic-float polishing of ceramic balls. (b) Magnetic-field-assisted polishing of rollers.

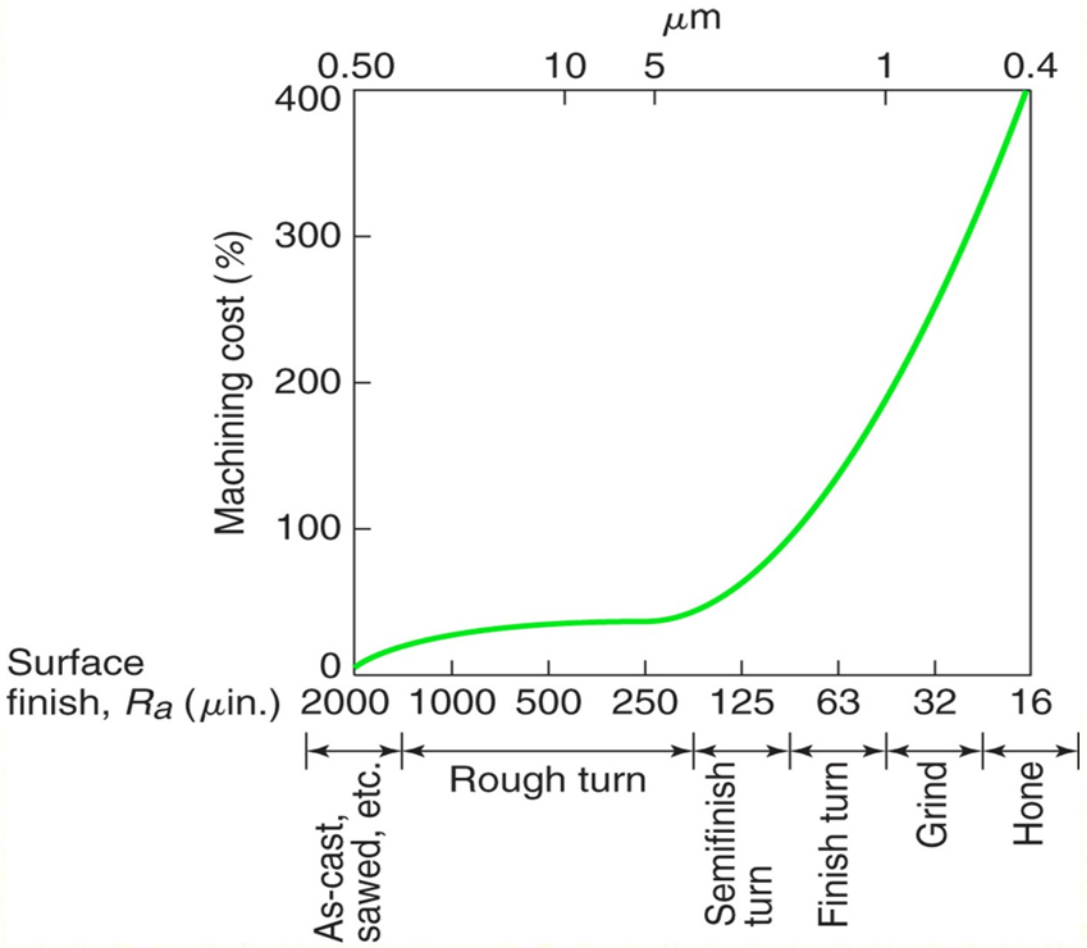
(a) Schematic illustration of abrasive-flow machining to de-burr a turbine impeller. The arrows indicate movement of the abrasive media. Note the special fixture, which is usually different for each part design. (b) Valve fittings treated by abrasive-flow machining to eliminate burrs and improve surface quality.



(a)

(b)

Increase in the cost of machining and finishing a part as a function of the surface finish required. This is the main reason that the surface finish specified on parts should not be any finer than is necessary for the part to function properly.



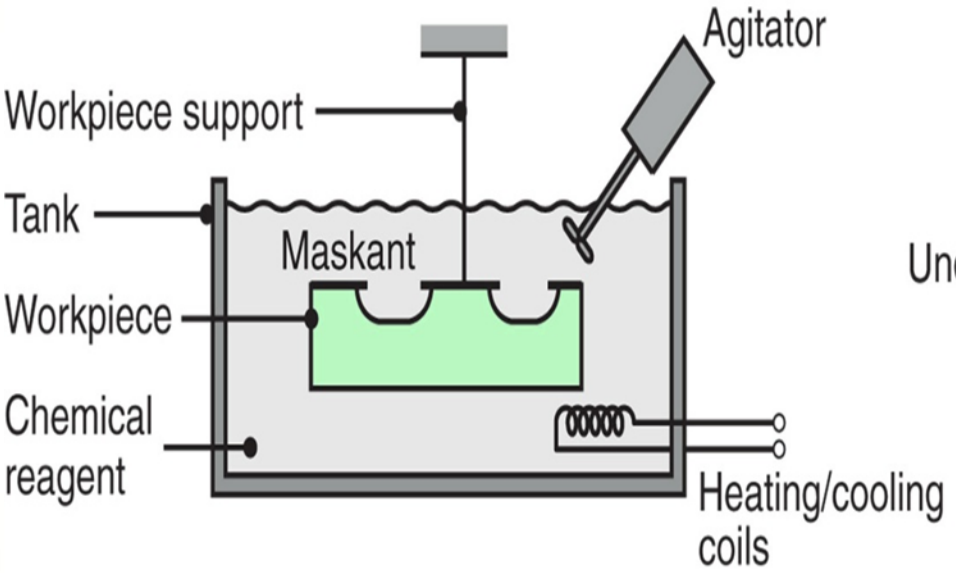
Advanced Machining Processes

- Strength and hardness of materials are very high
- The work piece material is too brittle
- The work piece is too flexible
- The shape of the part is complex
- Special surface finish and dimensional tolerance required
- Temperature rise and residual stress are not desirable

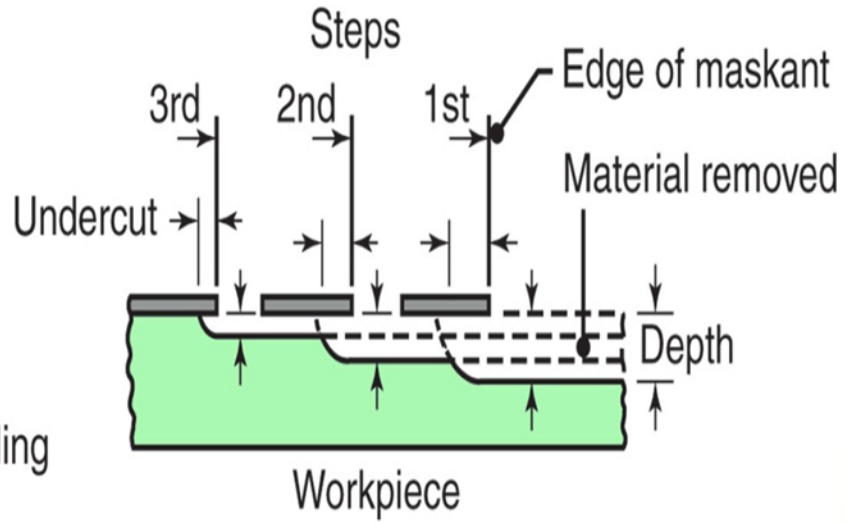
Types of Advanced Machining Processes

- Chemical machining
- Electrochemical Machining
- Electrochemical grinding
- Electrical discharge machining
- Wire electrical discharge machining
- Laser beam machining
- Electron beam machining
- Water jet machining
- Abrasive water jet machining
- Abrasive jet machining

(a) Schematic illustration of the chemical-machining process. Note that no forces or machine tools are involved in this process. (b) Stages in producing a profiled cavity by chemical machining; note the undercut.

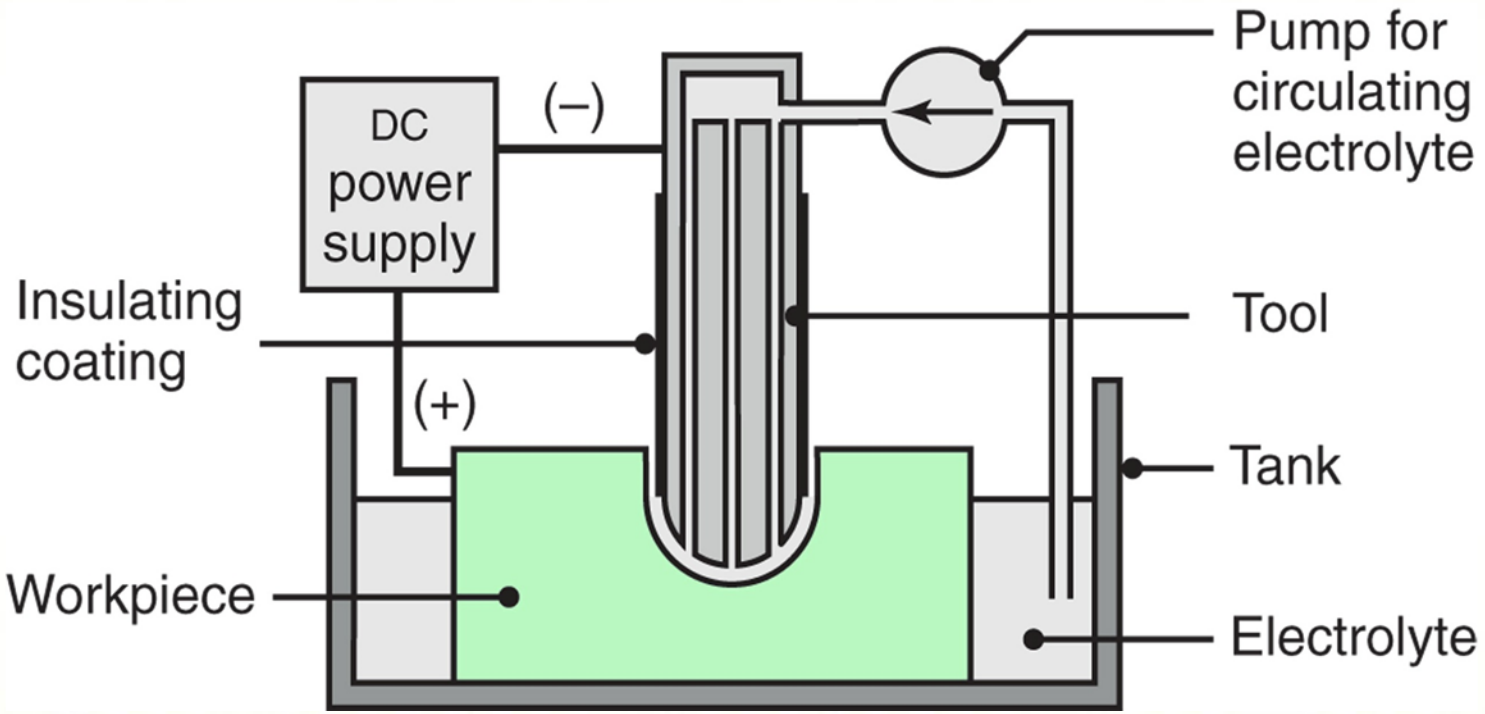


(a)

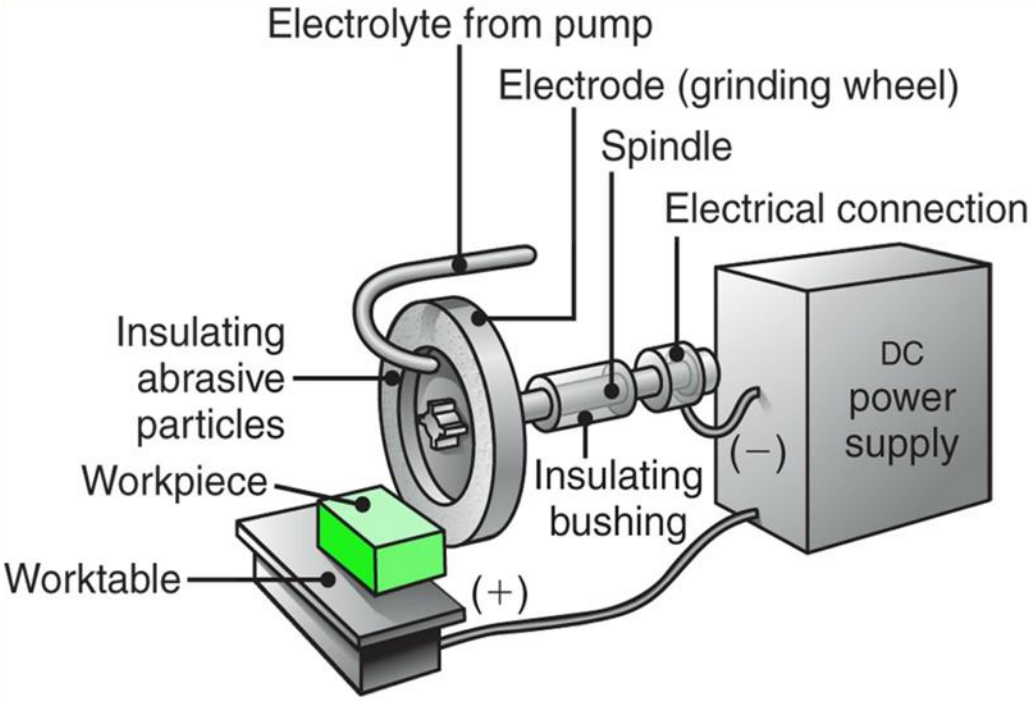


(b)

Schematic illustration of the electrochemical machining process



(a) Schematic illustration of the electrochemical-grinding process.
(b) Thin slot produced on a round nickel-alloy (Inconel) tube by this process.



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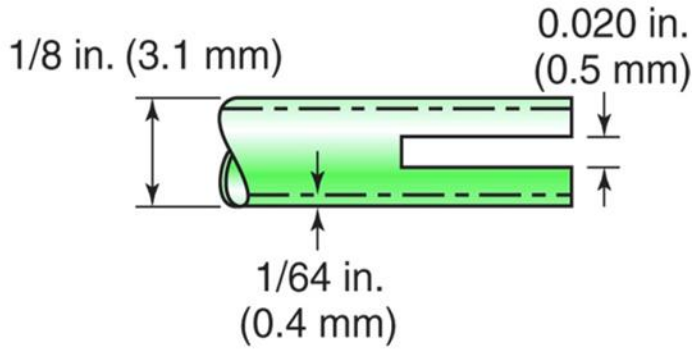
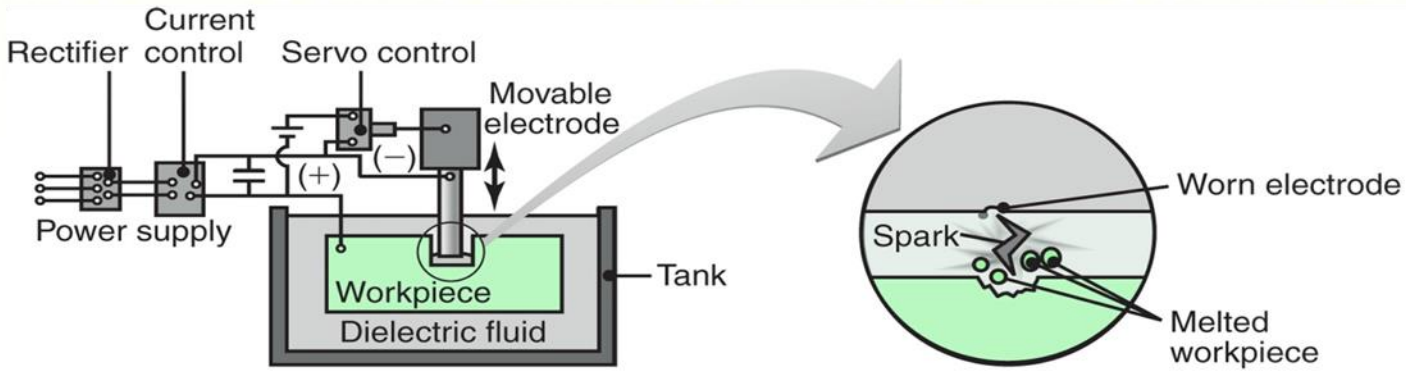
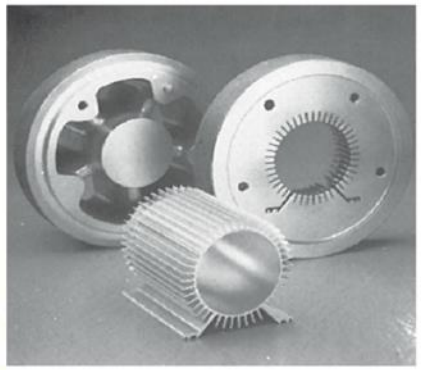


(b)

(a) Schematic illustration of for die-sinking applications. (b) Cavities produced by the electrical-discharge machining process, using shaped electrodes. (c) A spiral cavity produced by EDM using a slowly rotating electrode similar to a screw thread. (d) Holes in a fuel-injection nozzle made by EDM; the material is heat-treated steel.



(a)



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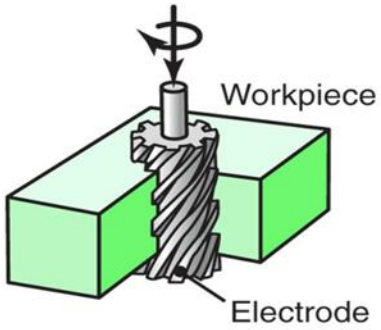
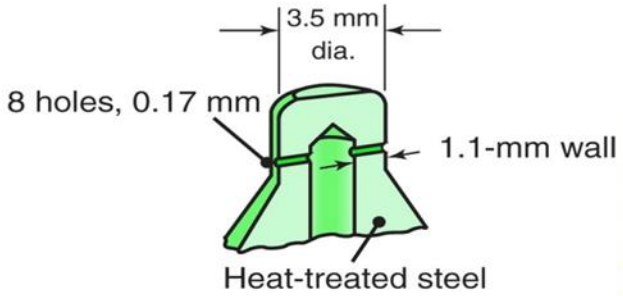
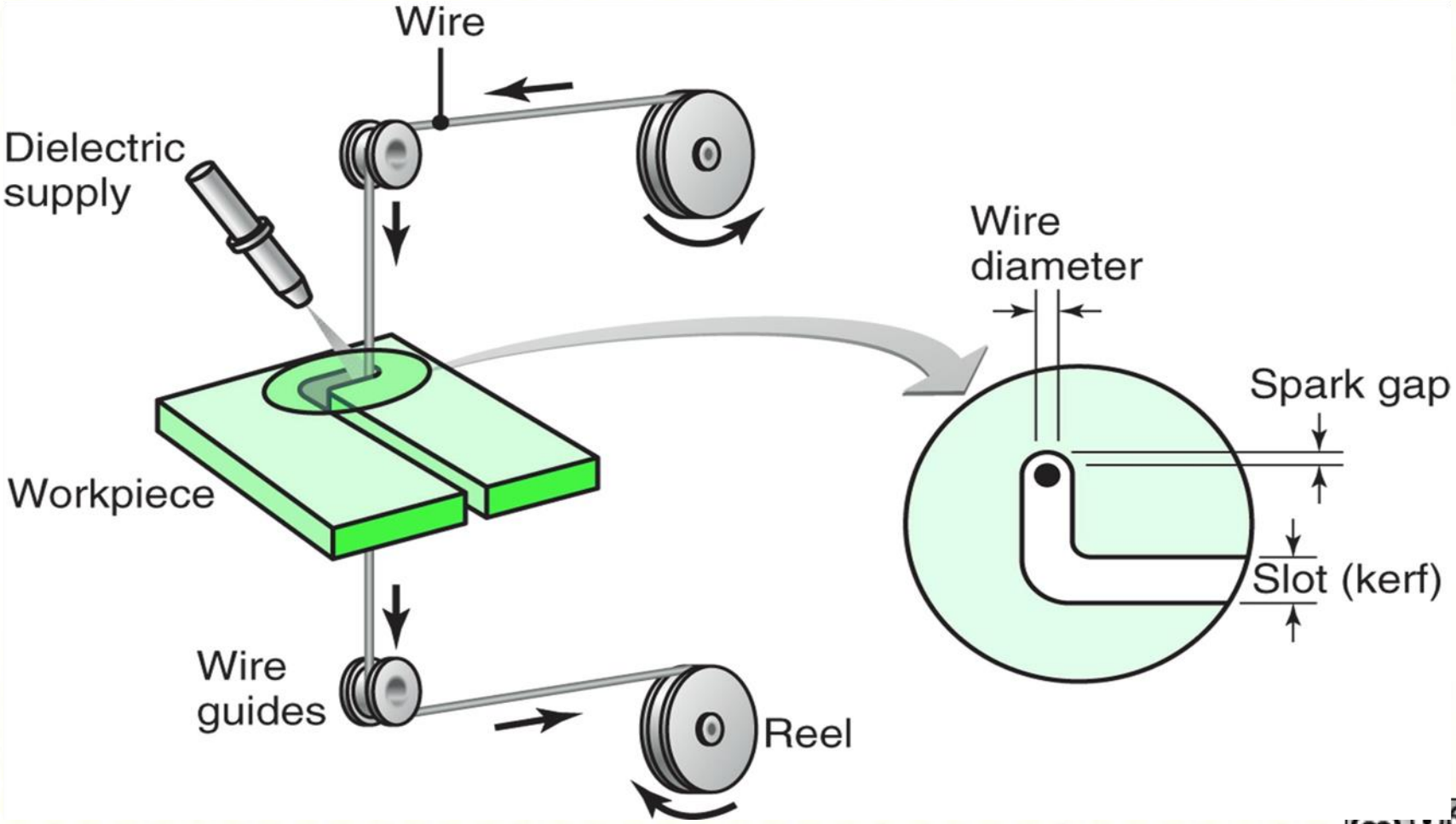


(c)

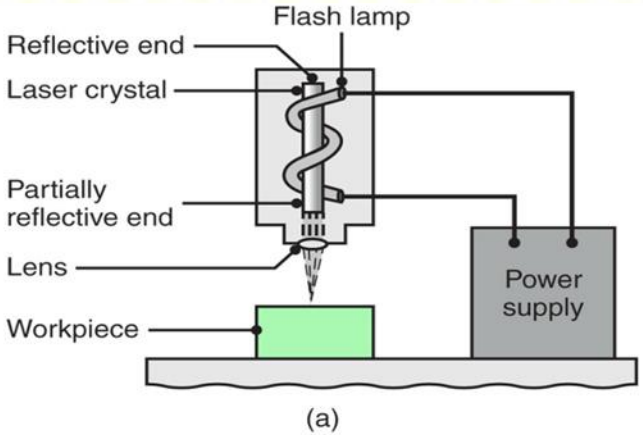


(d)

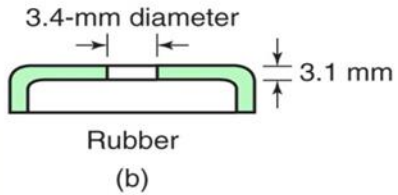
Schematic illustration of the wire EDM process. As many as 50 hours of machining can be performed with one reel of wire, which is then discarded.



(a) Schematic illustration of the laser-beam machining process. (b) and (c) Examples of holes produced in nonmetallic parts by LBM. (d) Cutting sheet metal with a laser beam.



(a)



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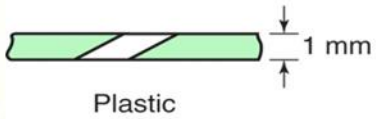
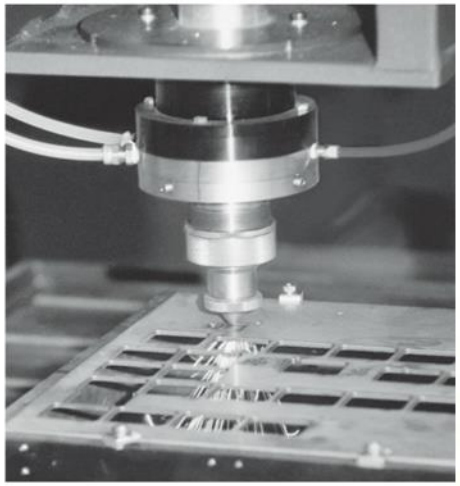
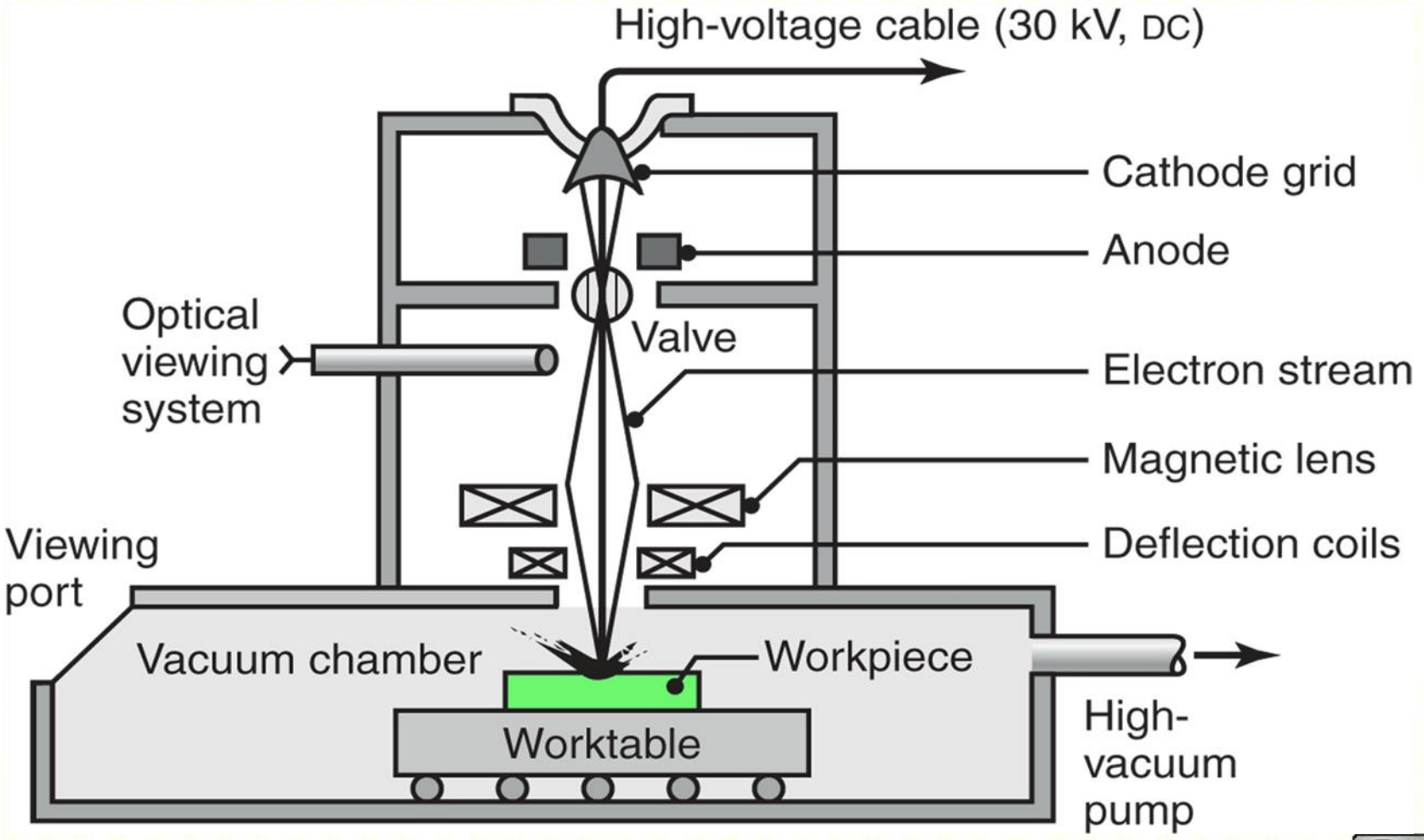


(c)

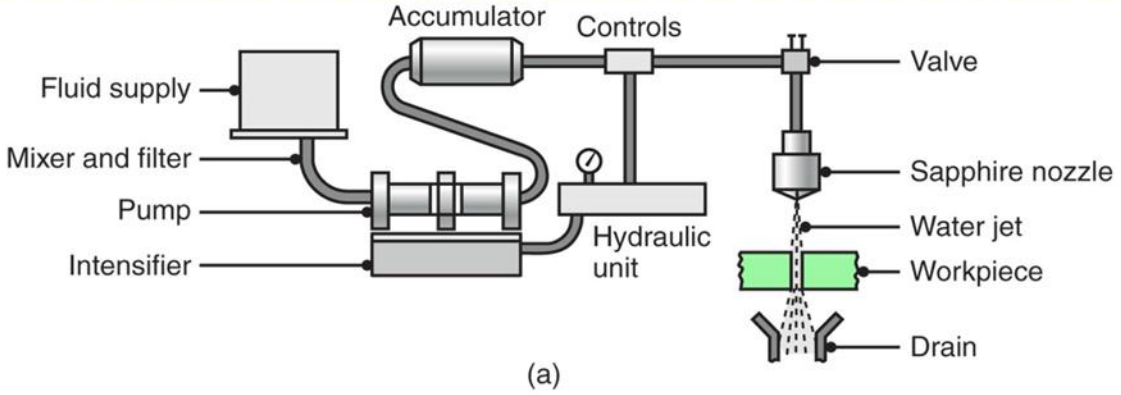


(d)

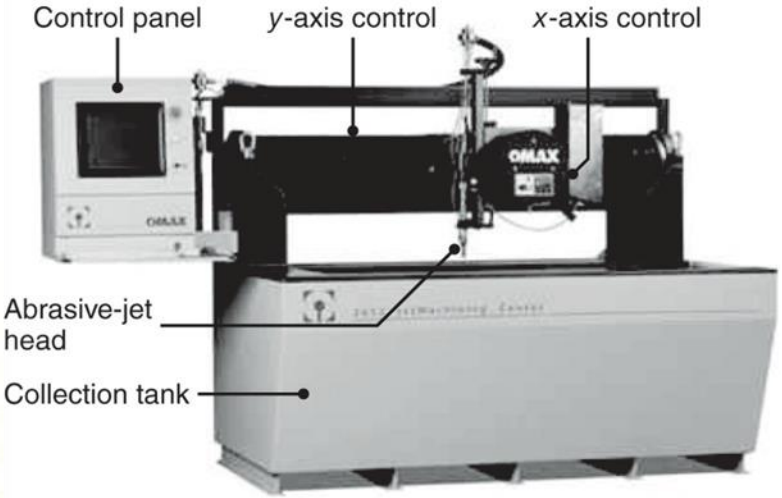
Schematic illustration of the electron-beam machining process. Unlike LBM, this process requires a vacuum, so the work piece size is limited to the size of the vacuum chamber.



(a) Schematic illustration of the water-jet machining process. (b) A computer controlled water-jet cutting machine. (c) Examples of various nonmetallic parts produced by the water-jet cutting process.



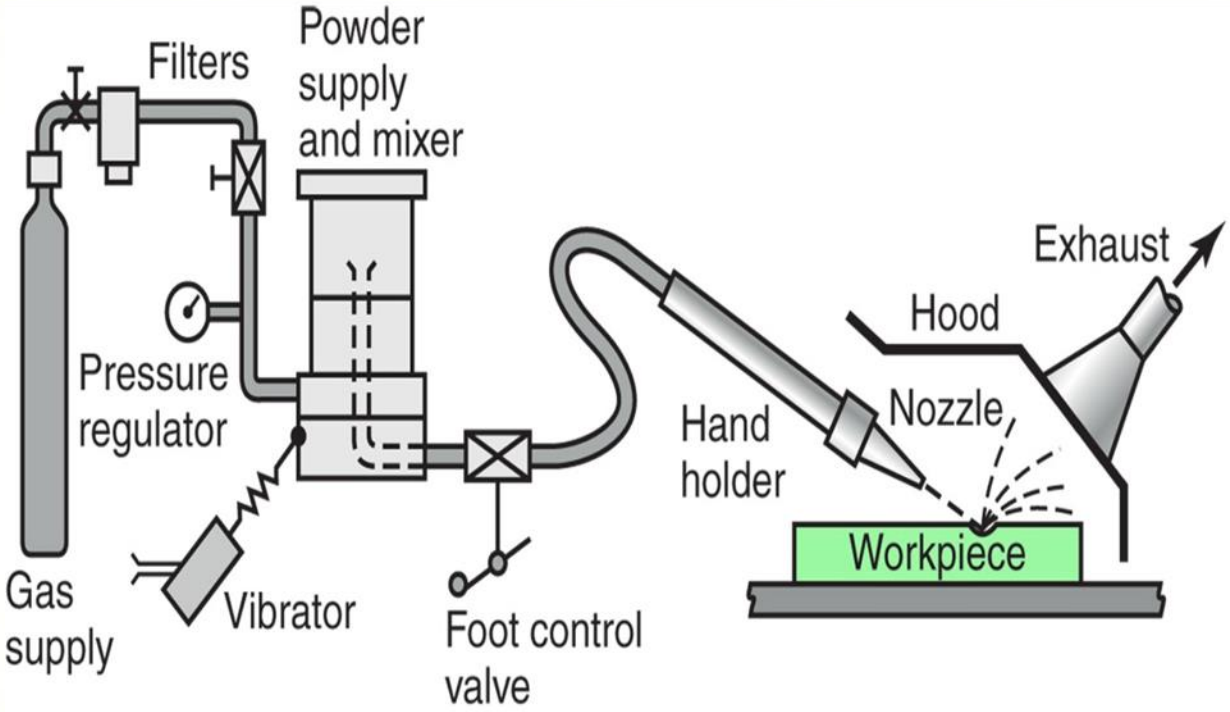
(a)



(b)

(c)

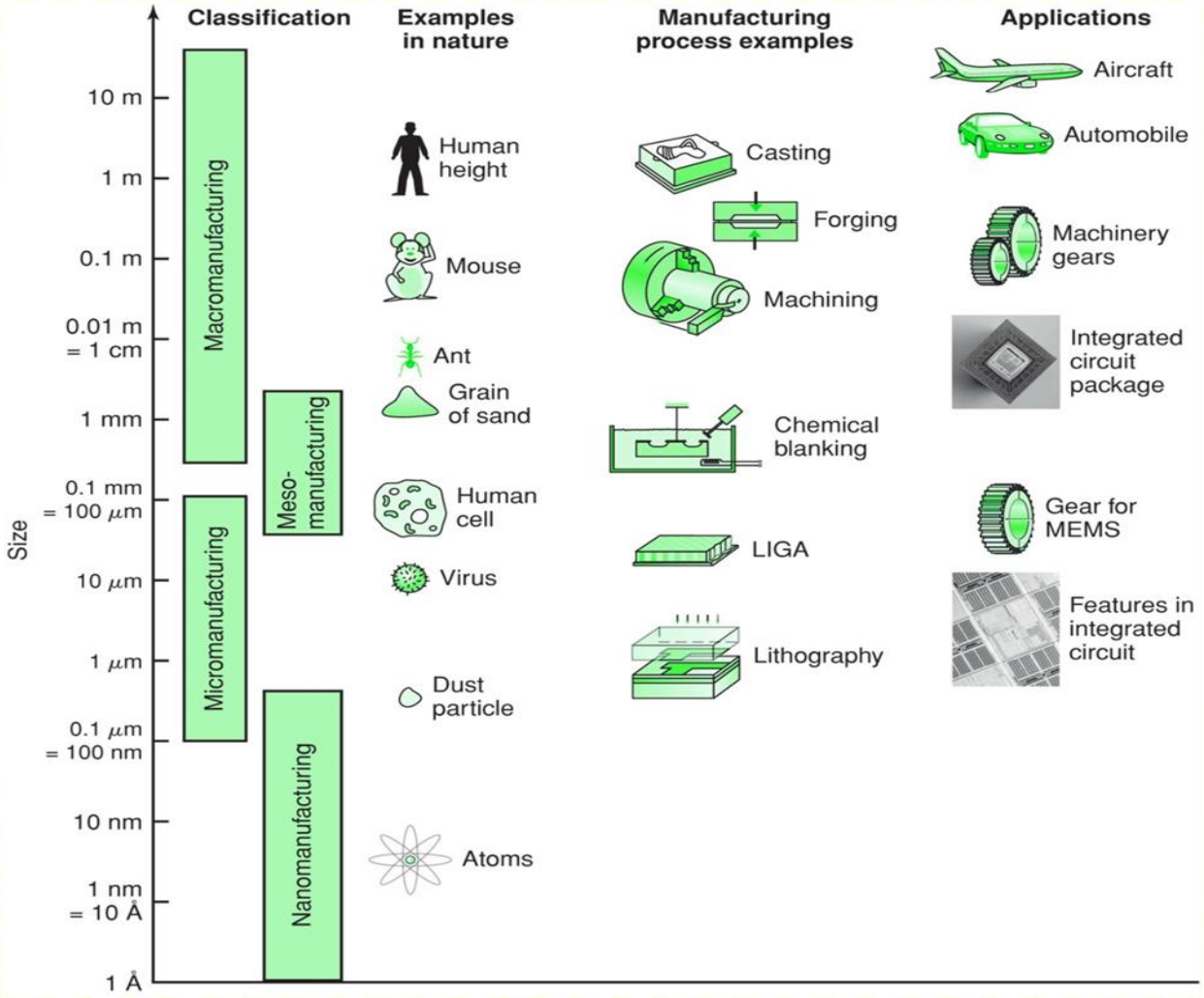
(a) Schematic illustration of the abrasive-jet machining process. (b) Examples of parts made by abrasive-jet machining, produced in 50-mm thick 304 stainless steel.



(a)

(b)

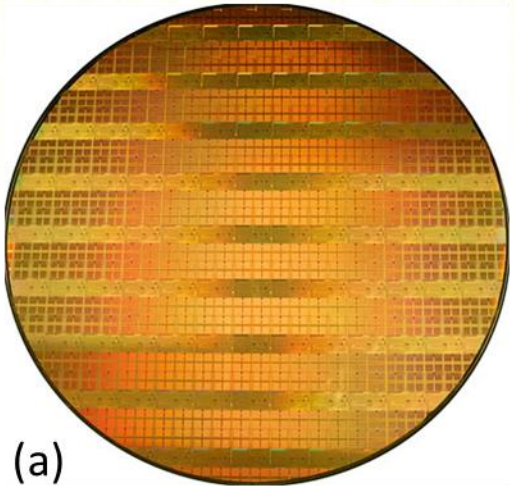
Illustration of the regimes of macro-, meso-, micro-, and nano manufacturing, the range of common sizes of parts, and the capabilities of manufacturing processes in producing those parts.



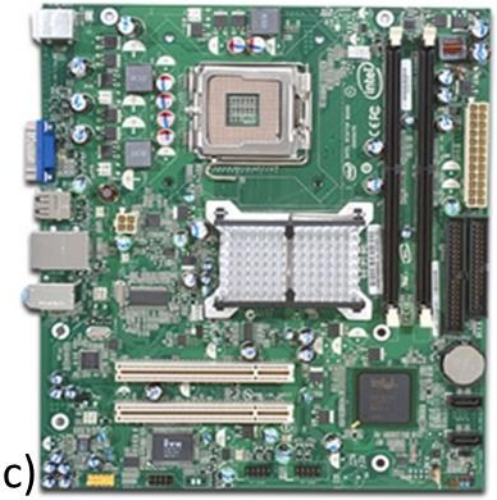
Fabrication of Microelectronics device

- Micro electronics has played an increasing role in over live (Integrated circuit)
- Major advantage of today IC are very small size and low cost
- Typical chip sizes are as small as 0.5 X 0.5mm
- Typical parts are Computer processor, memory chips, PCB (printed circuit Board) Integrated circuit of all types

(a) A 300-mm (11.8-in.) wafer with a large number of dies fabricated onto its surface; (b) image of the Intel® Itanium® 2 processor; and (c) Pentium® processor motherboard..



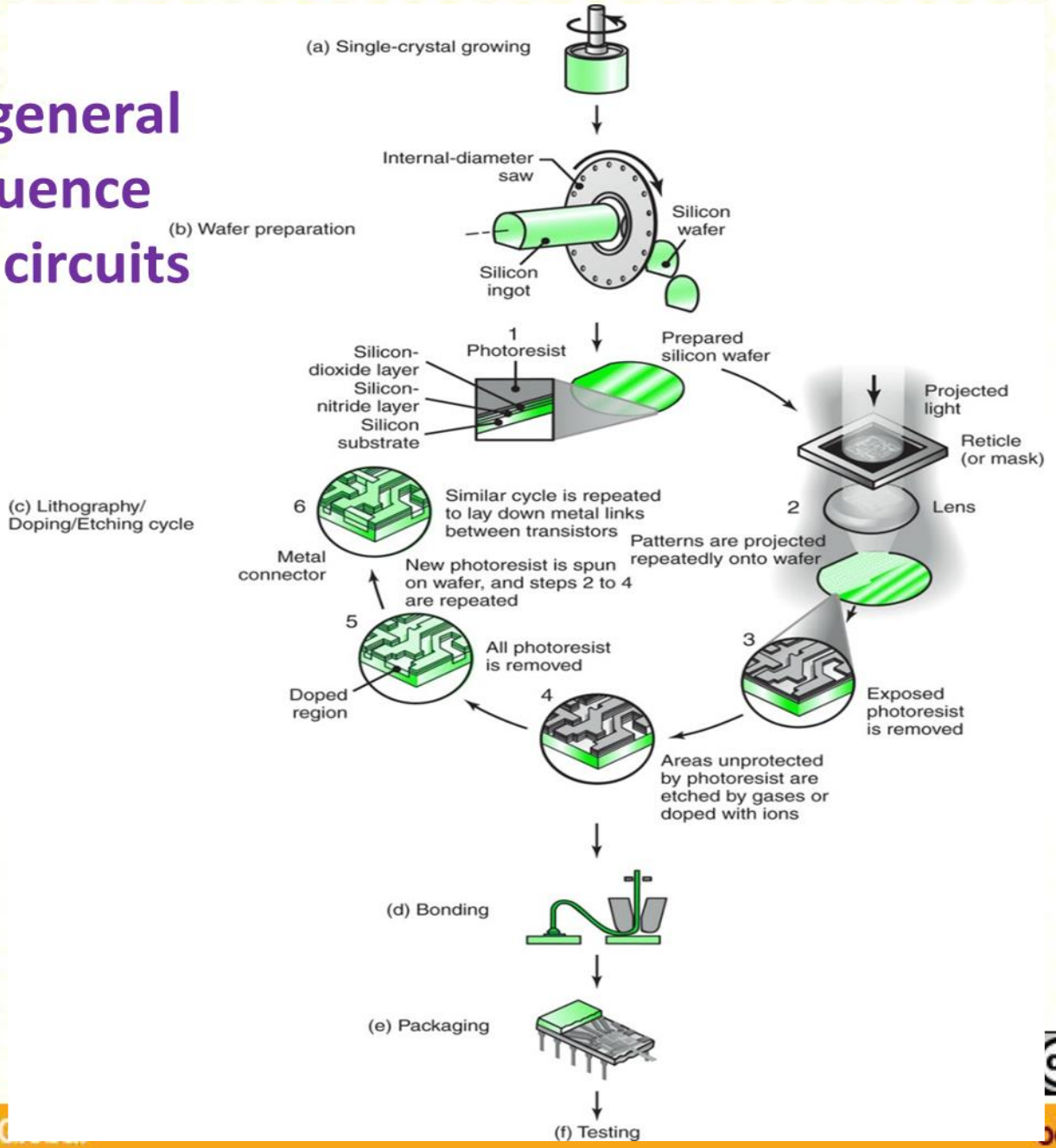
(a)



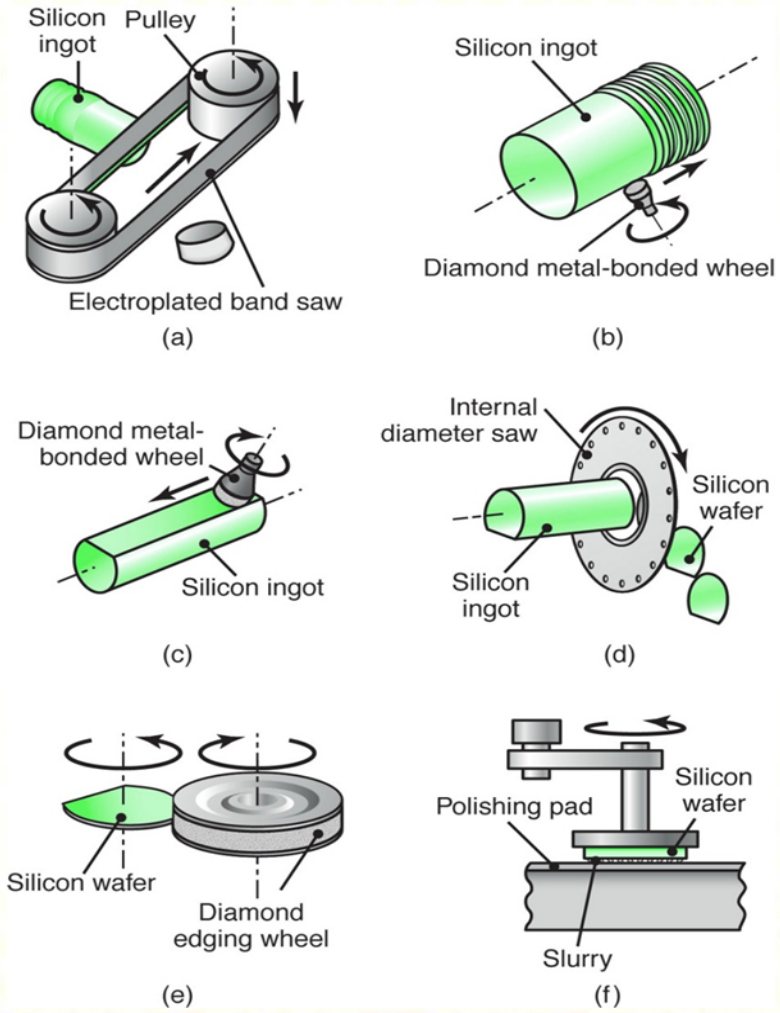
(c)

(b)

Outline of the general fabrication sequence For integrated circuits

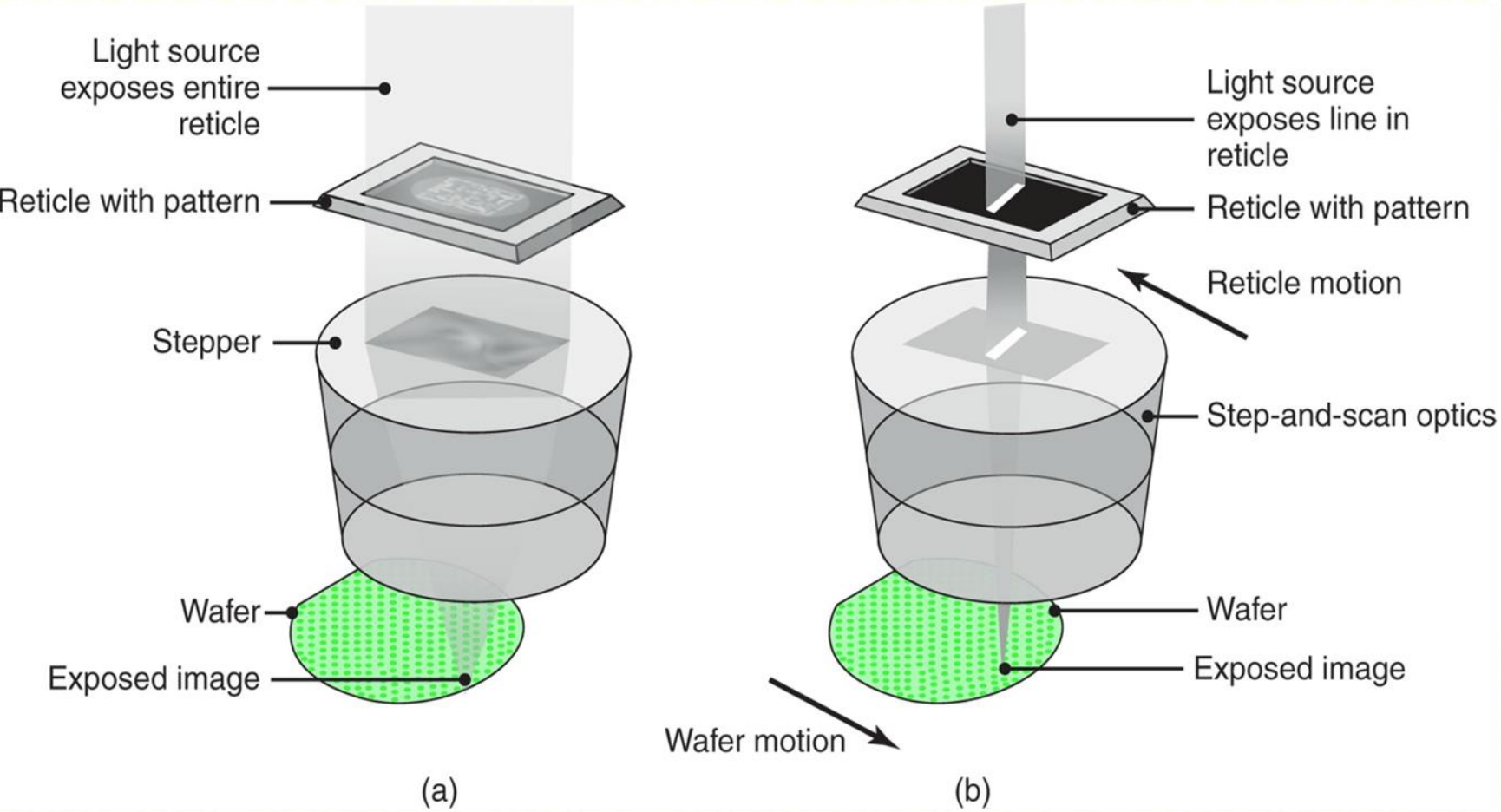


Finishing operations on a silicon ingot to produce wafers:

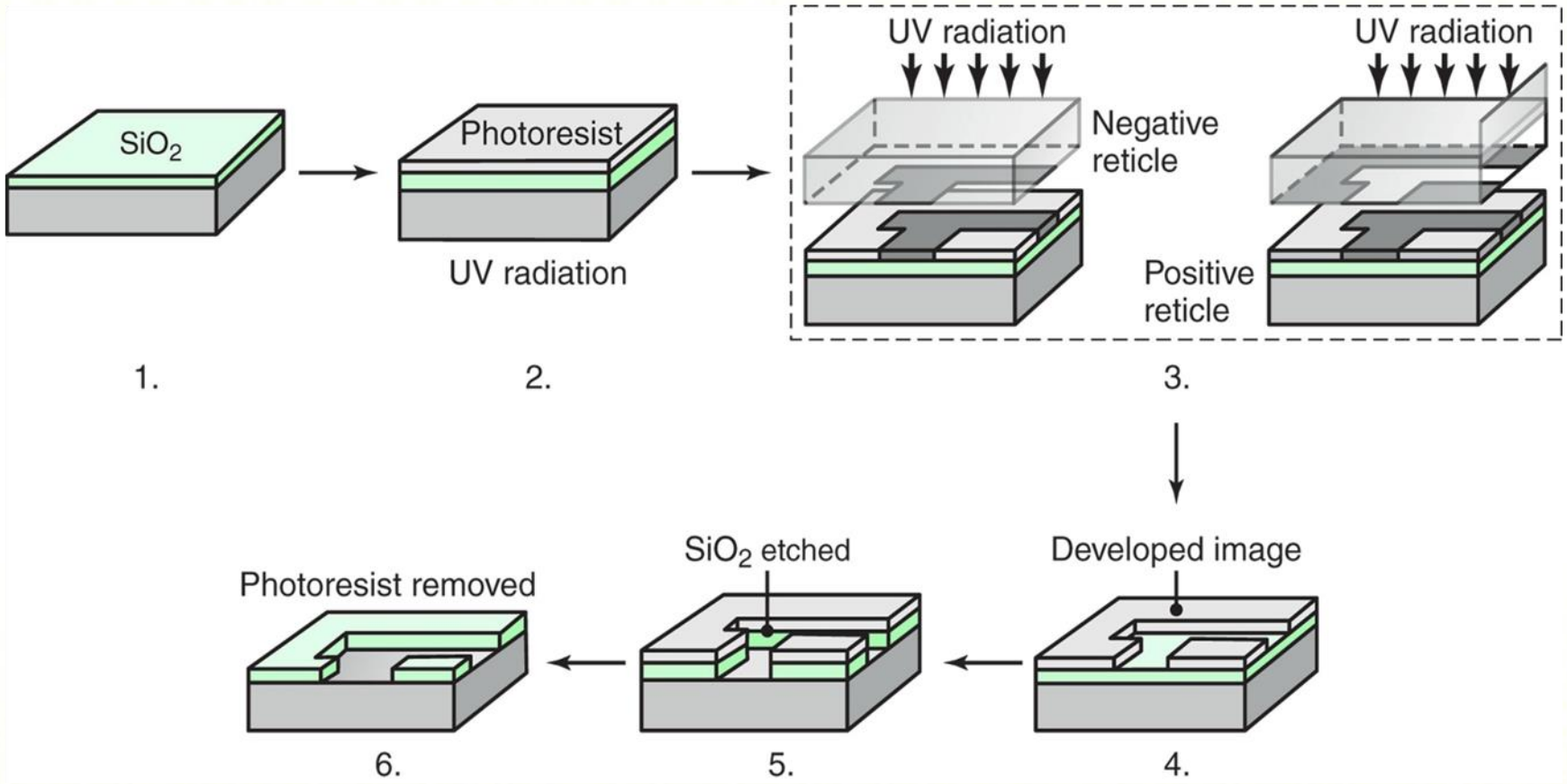


(a) sawing the ends off the ingot;
(b) grinding of the end and cylindrical surfaces of a silicon ingot;
(c) machining of a notch or flat;
(d) slicing of wafers;
(e) end grinding of wafers;
(f) chemical–mechanical polishing of wafers.

(a) wafer stepper technique for pattern transfer, and (b) step-and-scan technique.



Pattern transfer by photolithography. The mask in Step 3 can be a positive or negative image of the pattern.



Schematic illustration of the SCALPEL (scattering with angular limitation projection electron beam lithography) process

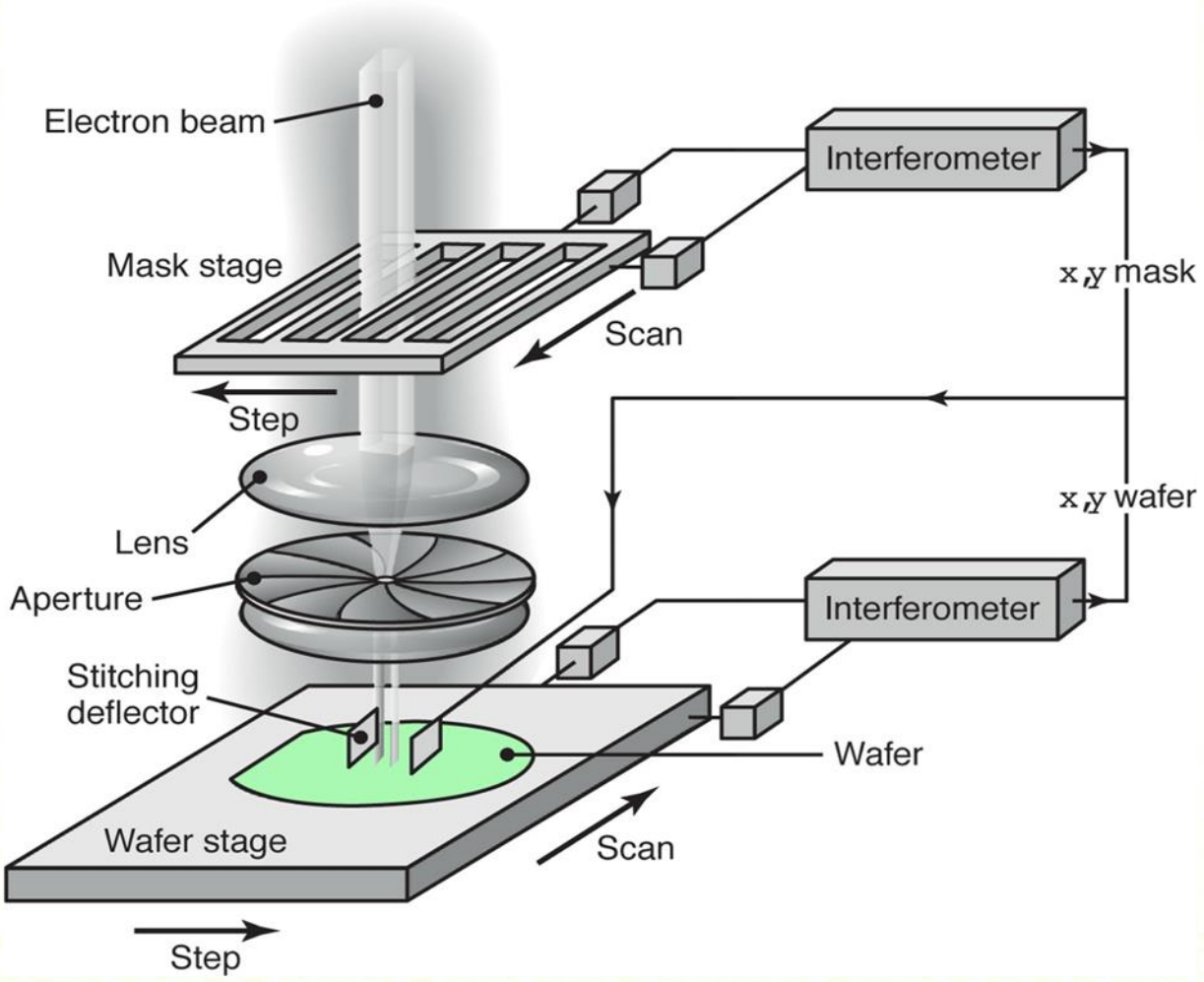
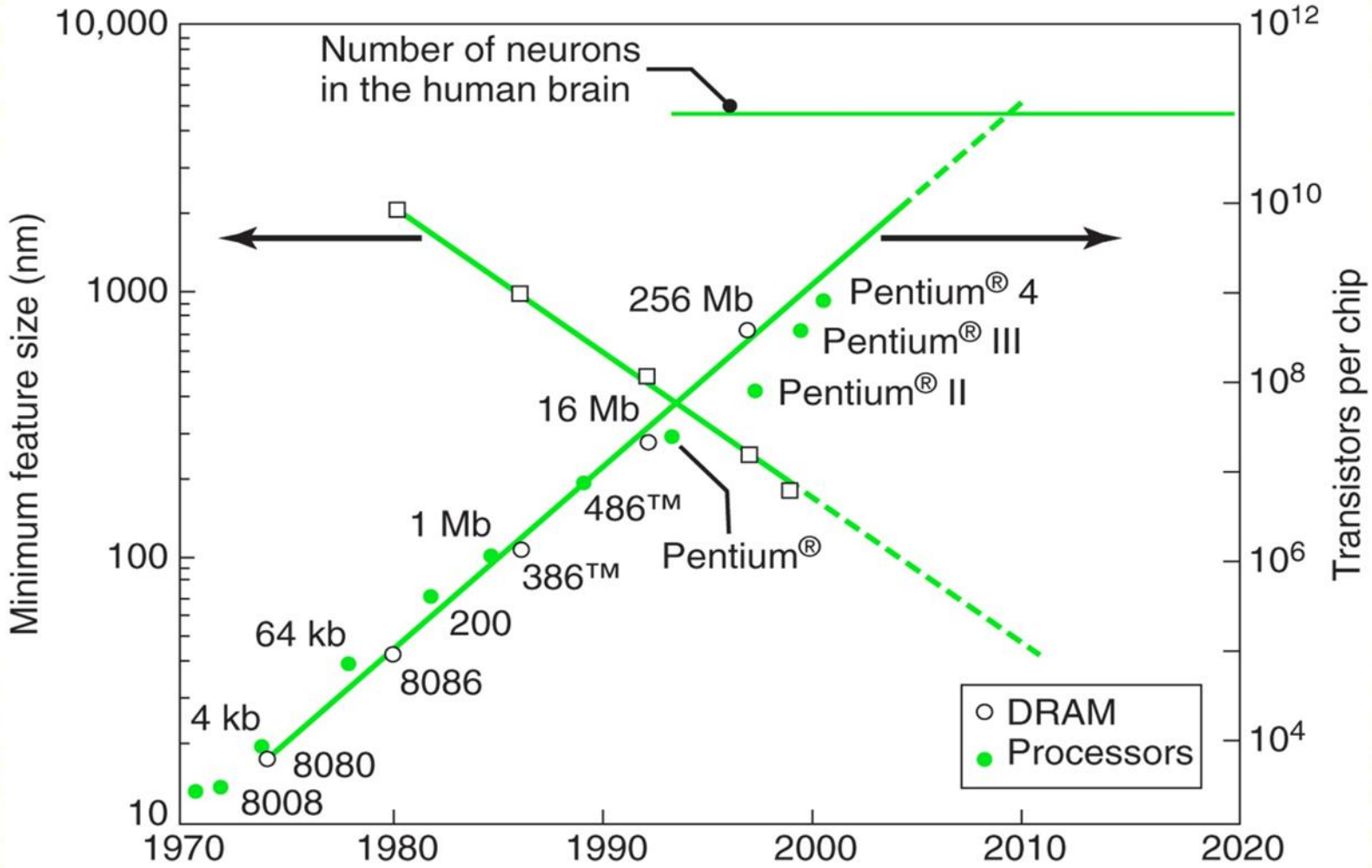


Illustration of Moore's law



THANK YOU