

## Solutions

1. Advantages: - Fast process

- Can be done in bulk
- Anisotropic etching allows for selectivity

Disadvantages: - Safety hazards and waste that comes from using chemicals

- Undercutting and over etching
- Chemicals require temperature regulations

2.

$$t = 22/60 = .367 \text{ minutes.}$$

$$1.6 * 0.367 = .587 \mu\text{m}$$

$$\text{vertical depth} = .587 \mu\text{m}$$

horizontal depth = .587  $\mu\text{m}$ . Isotropic processes etch the same rate in both the horizontal and vertical direction.

3.

The mask has a length of 15 $\mu\text{m}$ . In order to get a 5 $\mu\text{m}$  deep v-groove, the mask width must be  $2*(5\mu\text{m}/\tan(54.7^\circ)) = 7.1\mu\text{m}$ . Since the depth is 5 $\mu\text{m}$ , the time for etching is  $(1\text{min}/\mu\text{m})*(5\mu\text{m}) = 5 \text{ minutes}$ .

4.

Materials with different crystal orientations can be used to prevent an etch from continuing in a particular direction.

Boron etch stop: as regions of silicon become very heavily-doped ( $\sim 6 \times 10^{19} \text{ cm}^{-3}$ ), etch rates for common etchants drop dramatically.

Photolithography can provide enough energy to change the chemical structure of a layer such as photoresist. An etchant can then be selected which removes exposed or unexposed portions of material.