

Semiconductor Device Processing

Evaporated Metal Lift-Off Process

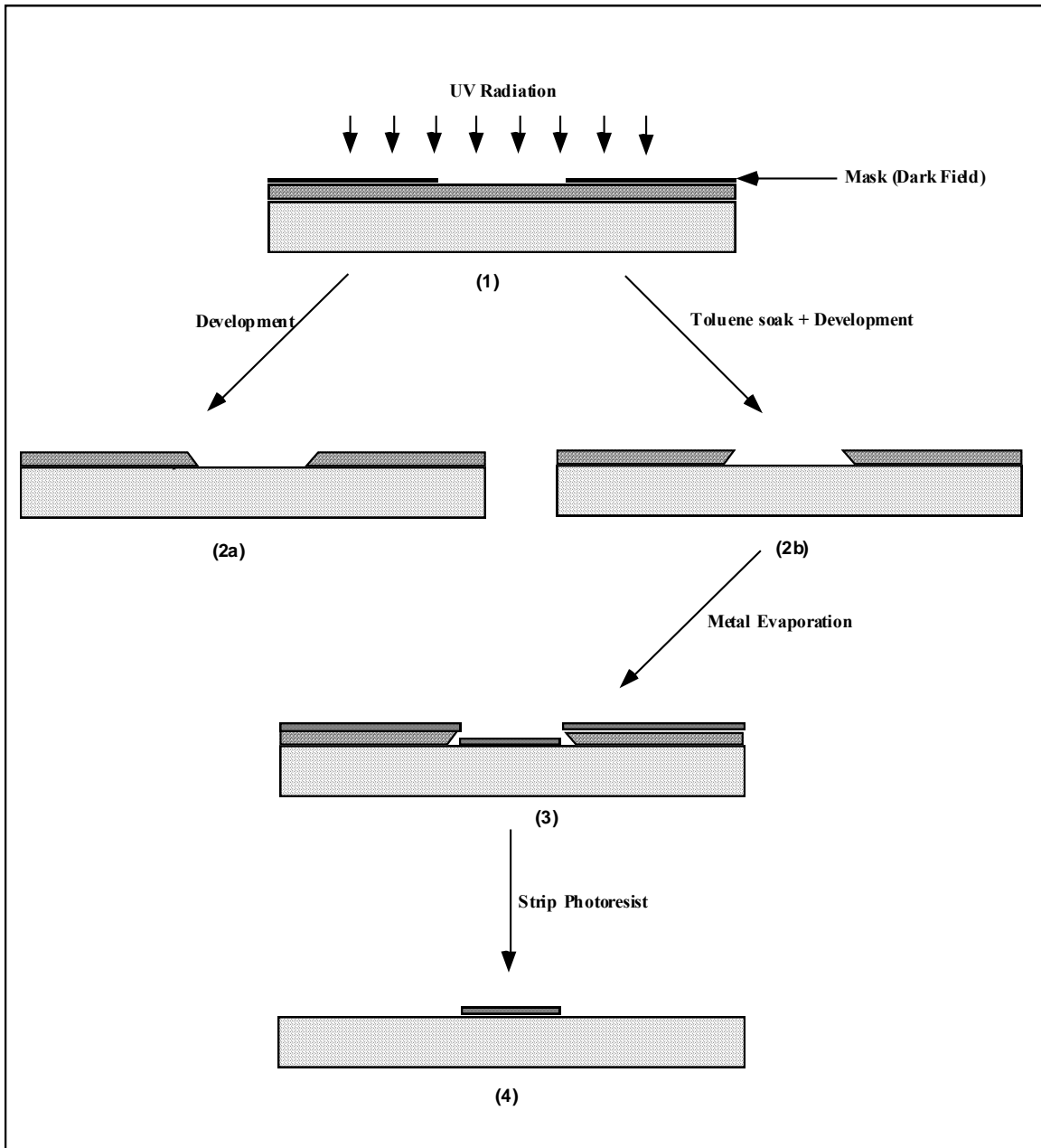
Metallization in a vacuum evaporator system is a line of sight process- metal is deposited over all exposed areas. In order to get metal selectively on certain regions of the wafer, a lift-off process can be used. The sample is first patterned using standard lithographic techniques such that photoresist covers regions where metal is not desired. The next step is to cover the entire sample with the metal. The metal thus contacts the substrate only in regions where it is required. The photoresist is then stripped away removing with it the metal in the undesired regions. An important feature of lift processes is that the side wall profile of the photoresist must be vertical or with an overhang. This causes a break in the deposited metal film (fig. 3) and ensures easy lift-off. After normal lithography the side walls are sloping (fig. 2a) and in order to get an overhang profile (fig. 2b) the lithographic process is altered slightly. A toluene (formerly chlorobenzene) soak step is included after the UV exposure but before development. The toluene hardens the top layers of the photo resist making them harder to develop away. In general, **the exposure time and the development time need to be changed from the optimal conditions** to account for the alteration of the resist properties due to the toluene soak. The flow chart for a lift-off process is included here.

Process sequence

1. Clean the sample using the standard procedure given in instructions set 1.
2. Spin on the photoresist (Clariant AZ 4110) and expose it to UV light on the MJB-3 aligner. Remember to use a dark field mask- the desired features are transparent and the background is dark. The detailed steps for the lithography are given in the lithography handout. **Do not develop the photoresist at this stage.**
3. Immerse the sample in a beaker containing toluene for 5 minutes. Blow dry the sample with N₂. **Do not** rinse the sample in DI H₂O after the toluene soak.

4. Now develop the photoresist using DI:AZ400K 4:1 developer using the standard procedure. **Never Postbake a sample that is intended for lift-off.** Rinse and dry.
5. Evaporate the desired thickness of metal in the vacuum evaporation setup. The detailed instructions are listed in the 'metal evaporation' handout.
6. Strip off the photoresist
 - a. Place the sample in a beaker containing acetone for about 15-20 minutes.
 - b. The acetone should strip off the photoresist thus removing the undesired metal. In case some metal does not come off, you may have to squirt some acetone over these regions to dislodge the metal. **Be gentle!**
 - c. Dip the sample in Isopropyl alcohol for 2 minutes to remove the acetone.
 - d. Rinse in DI H₂O for 1 minute.
 - e. Blow dry with N₂.

Flow chart for Lift Off Process



Legend

