

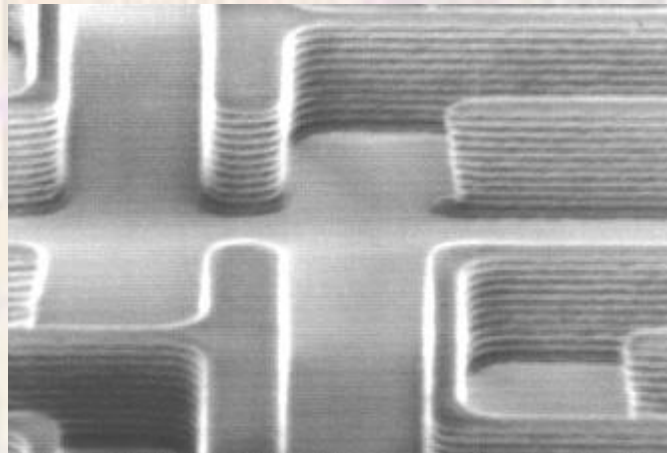
# Photolithography

Last updated 3/5/19



# Photolithography

- Photolithography
  - The process of creating an image (pattern) on a silicon wafer for further processing
  - 2 step process (many sub steps)
    - Photomask creation
    - Wafer patterning (lithography)



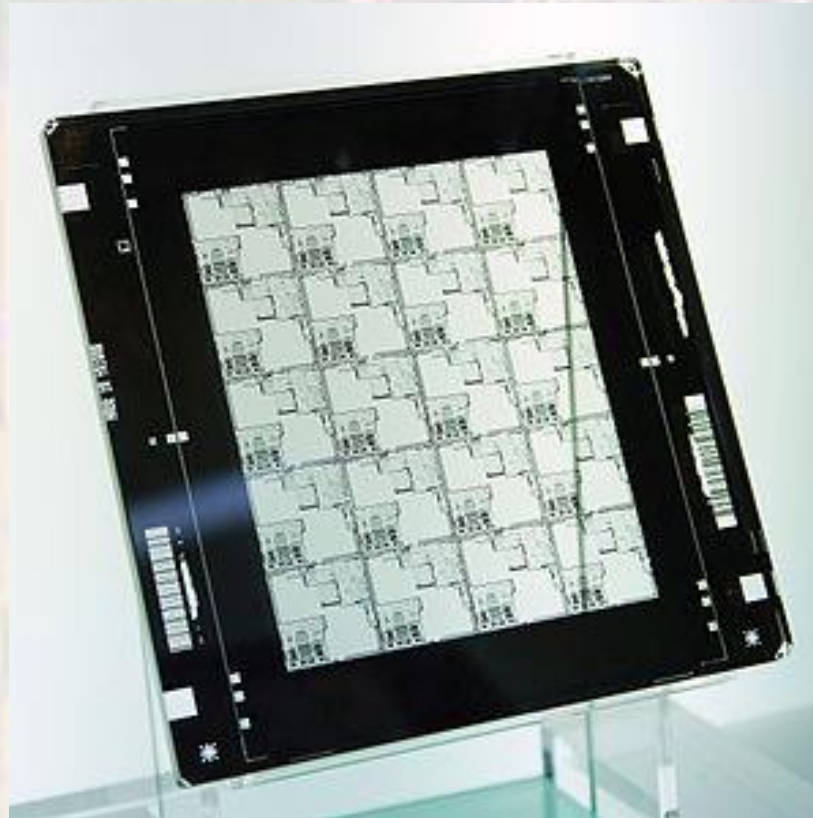
src: lithoguru

# Photolithography

- Photo mask creation
  - Glass or Quartz substrate covered with chrome
  - A photo-resist is applied across the substrate
  - Light (UV) or an electron beam is used to “write” the desired pattern onto the substrate/photoresist
    - Where the beam hits the photoresist it either becomes
      - Less soluble – negative photoresist
      - More soluble – positive photoresist
  - The mask is then cleaned with a photo-resist solvent
    - Leaving behind photoresist in the
      - Exposed areas – negative photoresist
      - Un-exposed areas – positive photoresist
  - The mask is then etched with a chrome solvent
    - Removing chrome wherever the resist is missing
    - Leaving chrome wherever the resists remains

# Photolithography

- Photo mask creation
  - The final mask is sandwiched between two glass or chrome pellicles to prevent the chrome from being damaged





# Photolithography

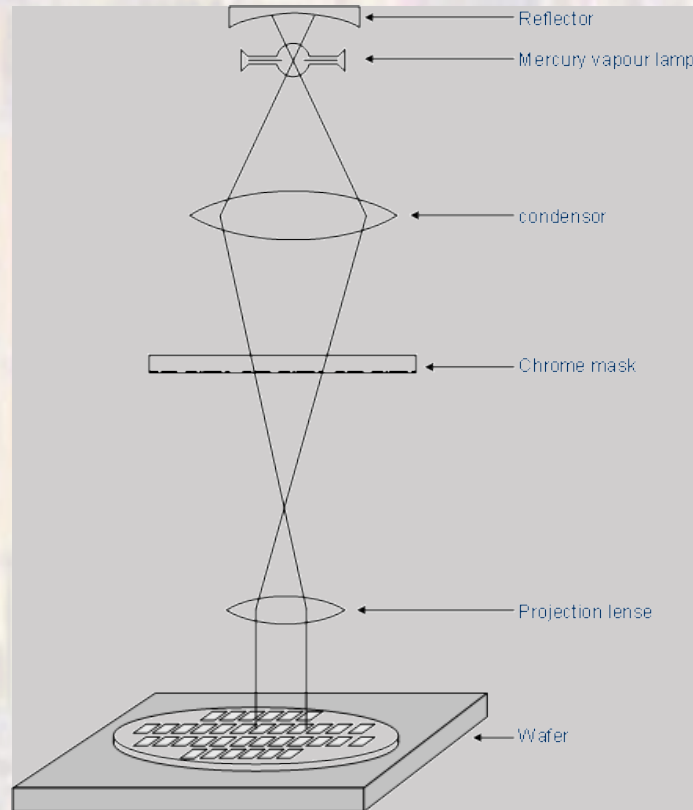
- Photo mask creation
  - Reticle vs. Mask
    - Mask is typically used to refer to a pattern that covers an entire wafer
      - Very rare today
    - Reticle is typically used to refer to a pattern that covers only part of a wafer
      - Reticles are “stepped” across the wafer to expose the entire wafer
  - Dimensions
    - Reticles are typically designed at 10-20x the final dimensions desired
    - The masks are then used with optical reduction techniques to pattern the final wafer

# Photolithography

- Wafer Patterning
  - The chemical process is very similar to the phot mask creation process
  - A photo-resist is applied across the wafer
  - Light (UV) or an electron beam is passed through the mask and onto the wafer.
    - Where the beam passes through the mask and hits the photoresist it either becomes
      - Less soluble – negative photoresist
      - More soluble – positive photoresist
  - The wafer is then cleaned with a photo-resist solvent
    - Leaving behind photoresist in the
      - Exposed areas – negative photoresist
      - Un-exposed areas – positive photoresist
  - The wafer is then processed in one of various methods

# Photolithography

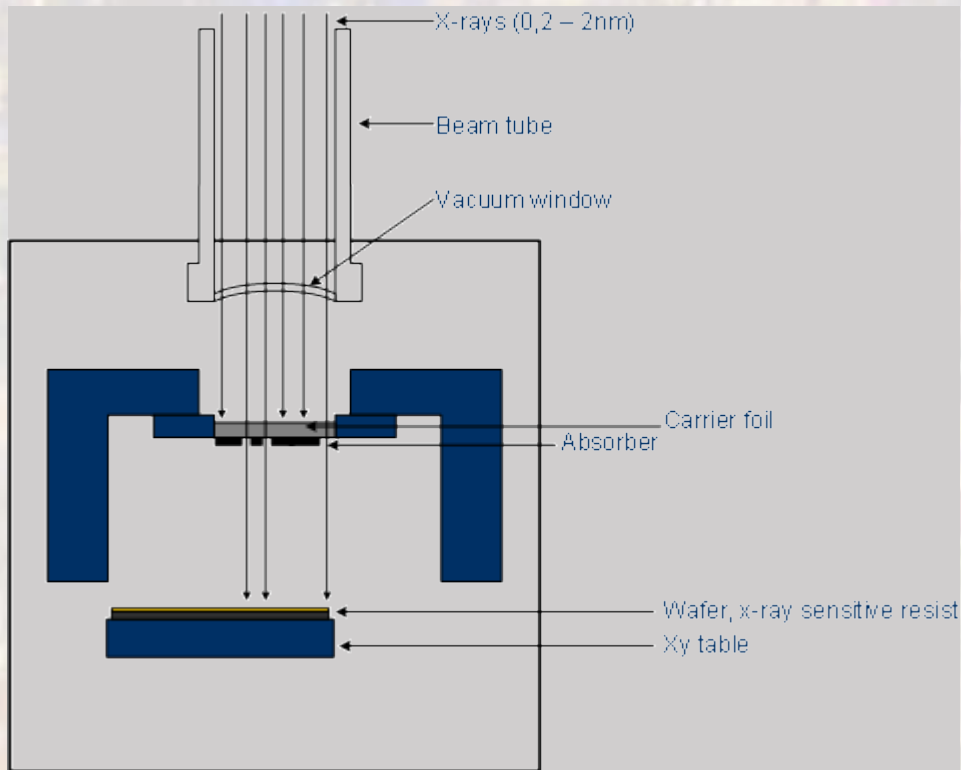
- Wafer Patterning
  - Typically reduction is used to pattern the wafer
    - Optical



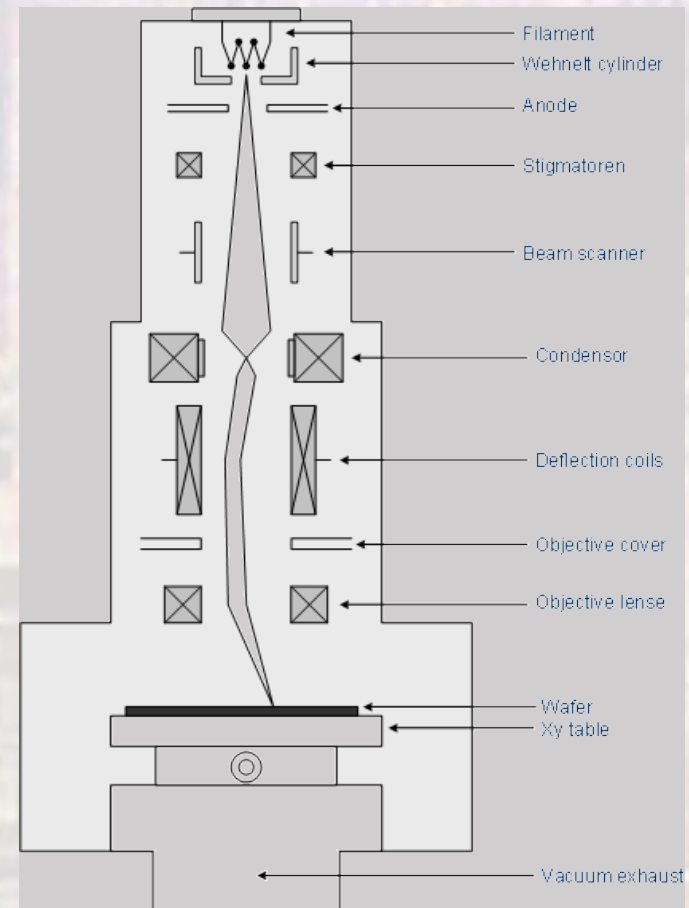
src: [www.halbleiter.org](http://www.halbleiter.org)

# Photolithography

- Wafer Patterning
  - Modern technologies use x-rays and electron-beams



src: [www.halbleiter.org](http://www.halbleiter.org)

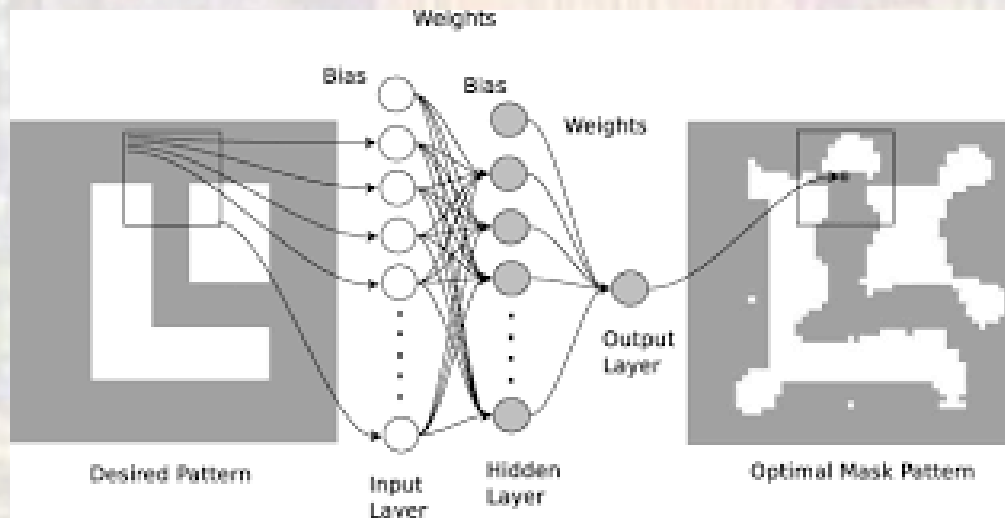


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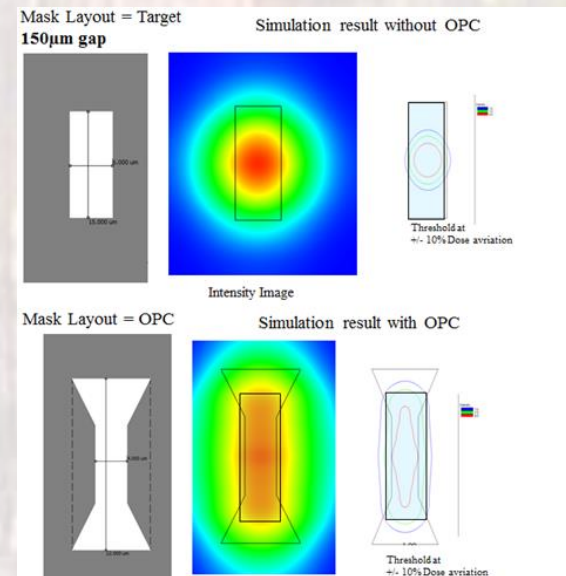


# Photolithography

- Optical Proximity Correction
  - Severe distortion occurs at current lithography sizes
    - Wave nature of electrons
    - Wavelength of optical sources
  - Optical proximity correction pre-biases the mask to account for these distortions



src: iopscience



src: GeniSys