5. Mask alignment
6. Exposure
7. Development
8. Hard Baking
9. Post Process cleaning.

[Note :- E- Beam Lithography :-
→ features are written by scanning 10 - 50 ke electron beam.
→ No necessity of mask.
→ can be used for preparation of mask.
→ very fine size (sub- micron or < 1 micr ~ 20 nm) features can be produced easil
no diffraction limit :- limited due to electron scatter.
→ Not suitable for higher length features
→ Developed in 1960s ; SEM technology.

☆ A technique that employs a focused bea of electrons for extremely precise patterning

Process :- ☆ The patter is written directly on the electron- sensitive resist (no mask is u
☆ More precise that photolithography or X- ray lithography.
☆ used to make high - resolution masks f photolithography & X - ray lithography.
☆ Beats the diffraction limit of minimu feature size around 5nm.

Construction :- ☆ Very slow. Takes over 10 hours to scan across the entire surfa

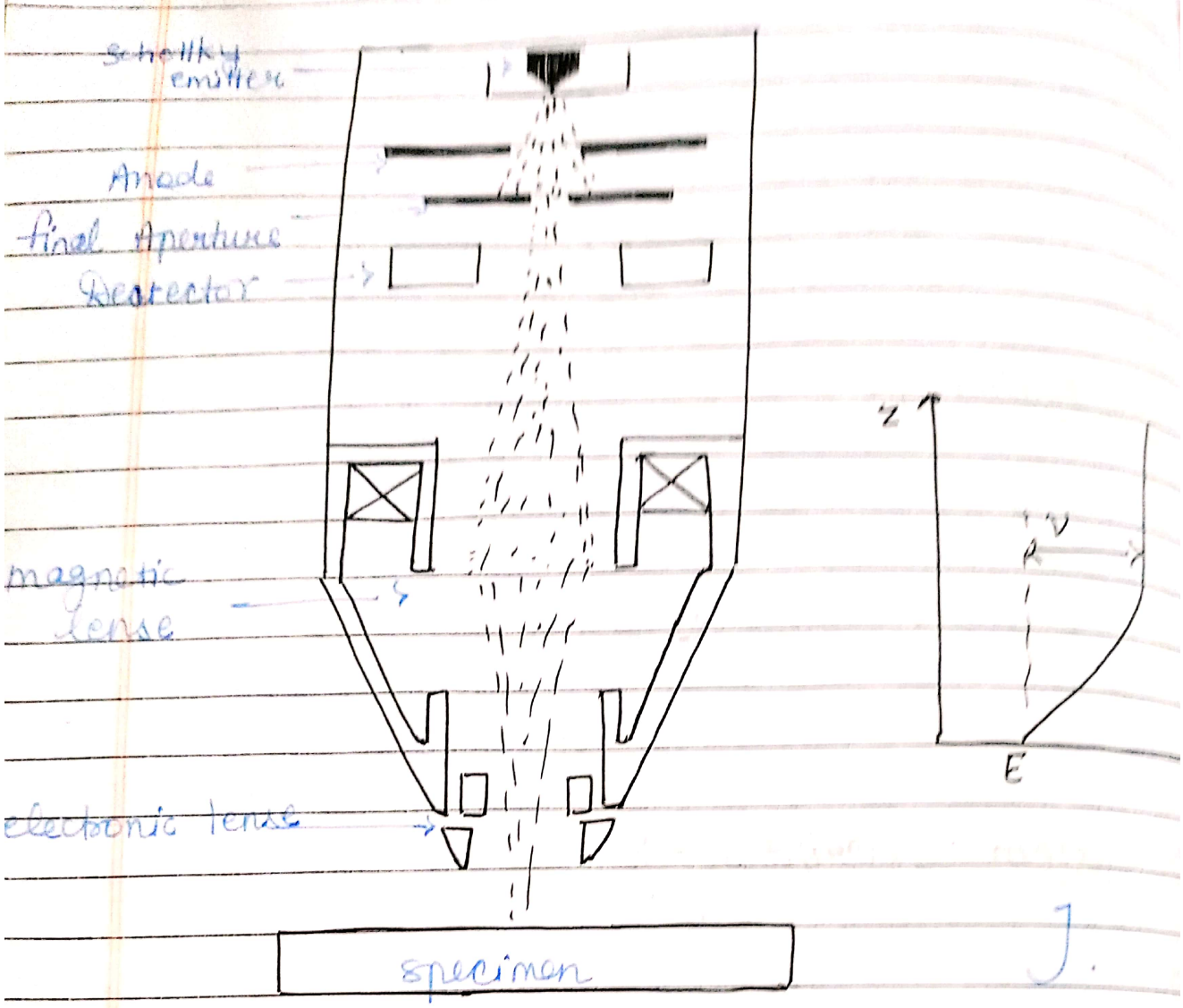
of a wafer
* Very costly. Once e- beam system reaches upwards of 5 to 10 million dollars
* Potential Problems with electron scattering :
→ electron energy : lower → very slow inefficient, damage the substrate
→ Electron energy : lower → lower penetration depth & lower resolution

⇒ Applications :- → Mask making for optical lithography
→ direct writing of ICs
→ opto-electronic devices, Quantum structure
→ Research application :-
* Enhancement of contact
* CNT powder growth using E⁻ beam.

⇒ System Description → An e⁻ gun or e⁻ source that supplies the e⁻
→ An e⁻ column that "shapes & focuses the electron beam
→ A mechanical stage that position the wafer under the electron beam.
→ A wafer handling system that automatically feeds wafers to the system & unloads them after processing &
→ A computer system that controls the equipments.

→ Electron Gun :- 1. Cathode :- Thermionic emitters; tungusten hairpin, LaB_6 or R field emitter
2. Sintered material or crystal

5. Schottky emitters



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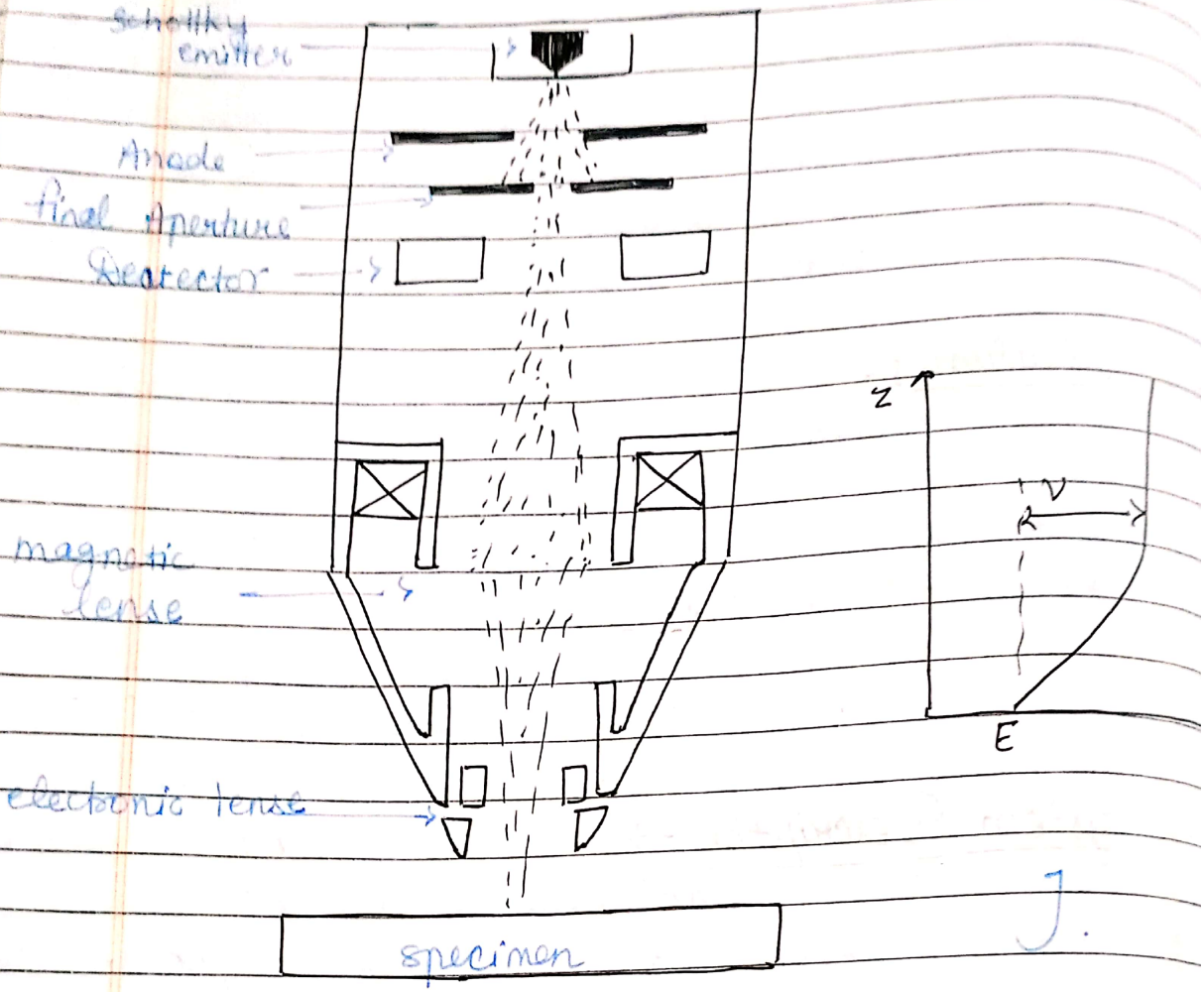
⇒ X-Ray Lithography :-

- ☆ High aspect ratio structure
- ☆ Optical materials opaque to small wave but transparent to x-rays.
- ☆ All e- resists are also x-ray resists, bec photoelectrons produced during x-ray e PMMA resist is usually used.
- ☆ X-ray masks different from or optical masks; Eg; Gold with thickness 0.7μm, 0.2 μm for 14.4 Å (Pd), 8.3 Å (Al) 13. Metal is thicker than Cr.

3. Schottky emitters.



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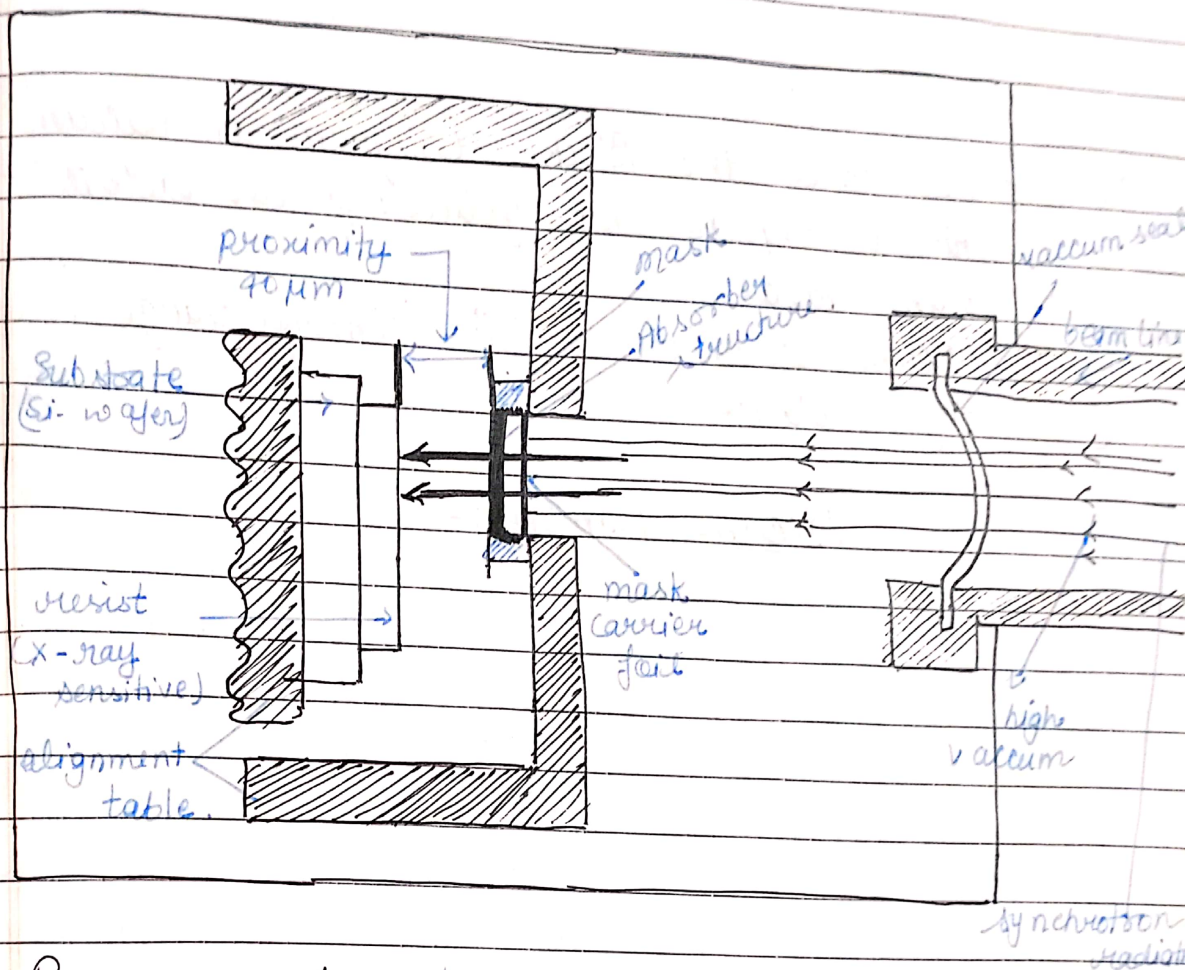
- ☆ All e- resists are also x-ray resists, beca photoelectrons produced during X-ray ab PMMA resist is usually used.
- ☆ X-ray masks different from UV optical masks: eg; Gold with thickness 0.7μm, 0.2 μm for 14.4 Å (Pd), 8.3 Å (Al). 13.2 Metal is thicker than Cr.

A Masks substrates, Polyamide, SiC, Si_3N_4, Al_2O_3.

→ X-Ray lithography is similar to traditional photolithography (use ultraviolet lithography).



Processor :- 1. Shorter wavelength (0.4-4nm) than uv light.

2. High penetration, high resolution.
3. minimum feature size around 10-20 nm
4. Simple process - can use both +ive & -ive resists.
5. Essentially negligible diffraction
6. Longer mask lifetime than with photolithography

Construction :- → very costly (compared to photolithography)

→ requires special masks and resists
* x-ray absorbers :- gold & tungsten
* x-ray membrane :- silicon carbide or diamond
→ x-rays cannot be focused → prevents the use of lenses.

1st Question :- Give the Block Diagram of vaccum (Repeated) unit & explain the following in detail :-
(i) Pirani Gauge → Repeated
(ii) Vaccum chamber (iii) Penning Gauge → Repeated
(iv) Baffle Valve

Solution :- Vaccum Chamber :- A vaccum chamber a rigid enclosure from which air & other gases are removed by a vaccum pump. It results in a low-pressure environment within the chamber, commonly referred to as a vaccum. A vaccum environment allows researches to conduct physical experiments or to test mechanical devices which must operate in outer space. or for processes such as vaccum drying or vaccum coating chambers are typically made of metals which may or may not shield applied external magnetic field depending on wall thickness, frequency, resistivity and permeability of the material used. Only some materials are suitable for vaccum use. chambers often have multiple ports covered with vaccum flanges, to allow instruments or windows to be installed in the walls of the