Short Questions on Electron Microscopy - 1

1. Electron scattering can be elastic or inelastic; is any energy lost by the incident electron during elastic scattering? yes, but $\frac{\Delta E}{E} \sim 10^{-7}$ at the normal sort of aperture angles used in CTEM

2. Under what circumstances does an incident electron gain energy as a result of interaction with matter? Interaction with phonons
phonon energy ~ kT ∴ gain << 1eV

3. What is incoherent elastic scattering?
almost No loss of energy by the beam and the scattering events are random and in no way related. eg. amorphous solids

4. Waves are supposed to propagate in a rectilinear manner - why then are we able to hear sound emanating from around a corner?
Sound wave 256 Hz $\lambda = 1.3$ m
∴ Doorway is a slit, since dimensions comparable to λ

5. Where is the specimen in a TEM located, with respect to the objective lens?
Immersed - diffuse boundary to lens

6. Are there any electrostatic lenses in modern TEM's?
Yes

7. Is the image formed at the Gaussian image plane of the objective lens of a TEM of the highest resolution?
No, there is a disc of least confusion

8. Why is it good practice to illuminate only a small area of a TEM specimen?
to avoid contamination

9. What is the cost of a conventional TEM?
£ 100 000

10. The resolution of a TEM increases with operating voltage. What are the major disadvantages of high-voltage microscopes?
Beam Damage, Stability of power source, cost

11. Is the inelastic scattering of electrons in a TEM a nuisance?
Can be used for chemical analysis, Kikuchi lines

12. What are the chances of obtaining well-defined Kikuchi lines from a 2500Å thick steel specimen consisting of untempered martensite?

13. Is it reasonable to examine a thin sheet of polythene in a high quality TEM operating at 100 kV?

14. Will the exposure times for photographic plates be the same when exposed to electrons accelerated through different potentials? (Assume beam currents identical.)
Higher exposure times

15. Is optical microscopy less useful than TEM?

16. Is it ridiculous to suggest that a leaky TEM column can be useful?

17. What is the disadvantage of a Lanthanum Hexaboride filament?

18. Is a top-entry TEM specimen stage better than a side-entry stage?

19. A steel specimen with a grain size of 1000 nm is examined in a TEM, in the diffraction mode, using conventional selected area diffraction methods. What sort of a diffraction pattern can we expect? How does this pattern alter if the grain size was < 5 nm?

20. How do we know that the interaction zone in a thick SEM specimen has the shape of a tear drop?

21. Is there an objective lens in a SEM?

22. Which, in terms of ability to achieve theoretical resolution, is better - an optical microscope or a TEM?

23. Would an image be recorded on a TEM photographic plate if the latter was accidentally placed with the emulsion side down, during exposure?

24. Is the camera constant for a TEM unique?

25. What is a cold trap?

26. Why do we sometimes "bake" a column?

27. Why should you be very embarrassed if you touched certain parts of a TEM specimen holder?

28. What would be the wavelength of an electron which moves in a potential energy minimum, compared with that of an electron which moves in a region of zero potential, if both the electrons have identical total energies?

29. Why would a piano tuner feel at home with a dispersion surface?

30. Do the lenses of a SEM magnify?

31. Can the aberrations of a TEM be negative?

32. How many extra electrons exist in an operating TEM column at any instant of time?

33. A perfectly flat steel specimen containing silica particles is observed in a SEM using secondary electron contrast. Will the silica particles appear darker than the iron?

34. Which SEM contrast mode is best for looking into voids?

35. A tank shell nose-cone is made up of very small tungsten particles sintered together with a Ni-based alloy. What SEM imaging mode would be best for determining the volume fraction of the particles?

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Short Questions on Electron Microscopy - 2

1. What would the electron diffraction pattern of a spinodally decomposing alloy look like?

2. Is it possible to find a diffracting vector which renders a mixed (edge + screw components) dislocation invisible?

3. Which has a wider image (Bright field, 2-beam conditions), an edge dislocation or a screw dislocation?

4. Does the $\underline{g}.\underline{b}$ invisibility criterion work for interface dislocations?

5. Is the Bloch wave from the upper branch of the dispersion surface preferentially excited for $S>0$?

6. Under what circumstances do stacking faults fail to exhibit fringe contrast, assuming that $\underline{g}.\underline{R} \neq 0$?

7. How is anomalous absorption in a TEM specimen related to the production of electron channelling patterns in the SEM?

8. Are X-rays scattered more effectively than electrons?

9. Explain the large mean free path of electrons in crystalline materials.

10. Electrons follow a straight line path down the microscope column - do they?

11. Why is the back-scattered mode of SEM imaging not useful for electrical or magnetic contrast?

12. If the dispersion surface had the size of a football, what would the size of the Fermi surface be?

13. A bent specimen is observed, in a TEM, to exhibit a bright bend contour. If the same specimen is examined in an SEM (back scattered mode, identical orientation with respect to beam), what is the shade of the bend contour relative to the background?

14. What would you expect to see at a flat p-n semiconductor junction, observed in the SEM using back-scattered electrons?

$\underline{g}(\underline{b} \times \underline{u})$, $\underline{g} \cdot \underline{u}$ contrast is symmetric.

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