Exam Date & Time: 09-Dec-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV/DEC 2023

Materials Characterization [MME 4074]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions. Section Duration: 180 mins

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) SEM-EDS, TEM, XRD & XRF instruments are available in the materials testing laboratory. Identify the most suitable instrument along with low-cost materials characterization technique if engineers want to understand the crystalline nature of material. Describe the important parts of the instrument along with their main functions. (4)

A)

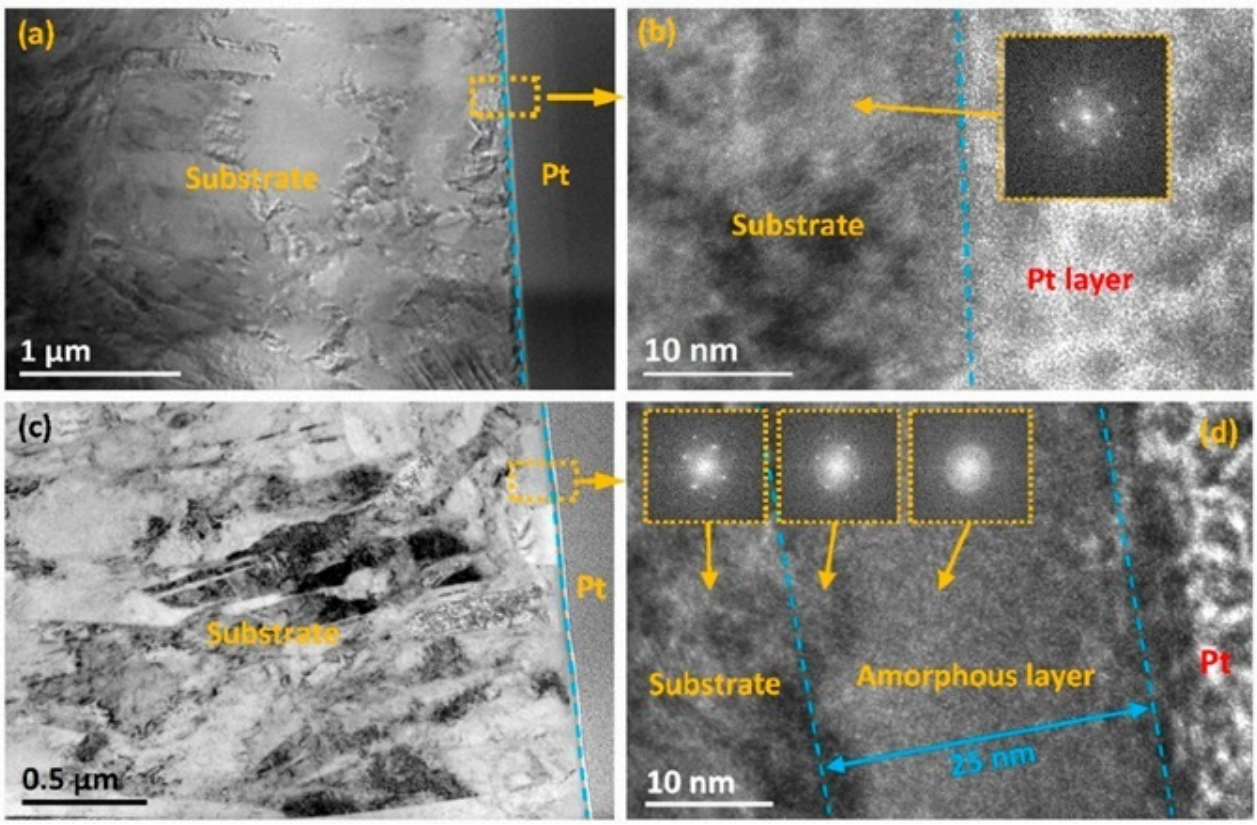
B) ASTM grain size number 8 is better than that of ASTM grain size number 3. Discuss the same for pertaining to the component undergoing fatigue loading applications. (3)

C) Discuss the different types of transmitted electrons and their utilization with respect to output in the TEM instrument. (3)

2) Deliberate use of etchants in getting the microstructure for the given component. (3)

A)

B) Discuss the below TEM images obtained on cross-sectionals of (a & b) martensitic stainless steel & Pt layer (c &d) martensitic stainless steel + (Ti + N) dual implanted & Pt layer samples. (4)



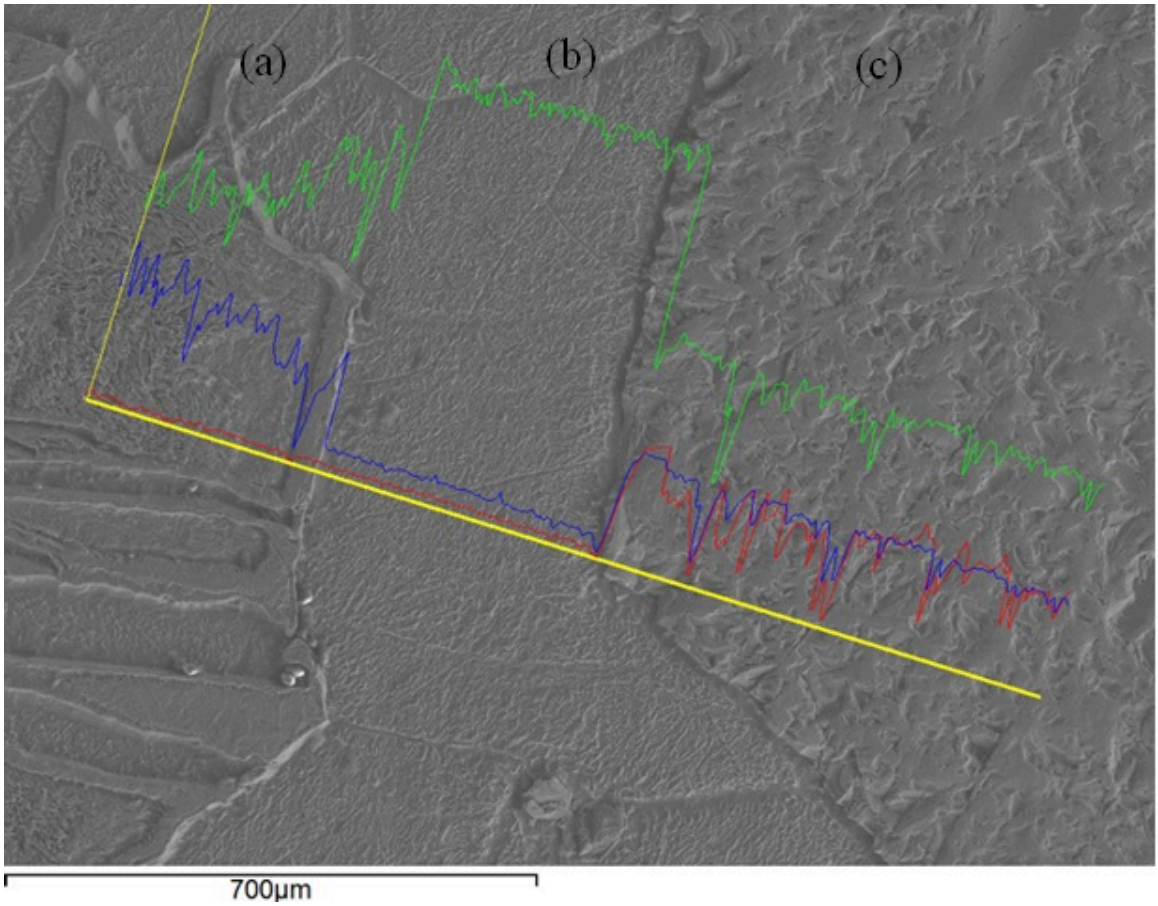
C) Lathe/CNC cutting tools have PVD-CVD multilayer coatings to enhance the tool wear. Suggest a suitable technique and describe its working procedure to characterize these multilayer coatings. (3)

3) SEM instrument can be utilized to characterize the fractography of various samples. Justify the statement. (3)

A)

B) Discuss the must have sample characteristics for the TEM characterization. Suggest the prerequisite conditions before using HR TEM. (3)

C) The below SEM-EDS analysis carried on surface texture of the sample: The thick yellow line is the line that was scanned. Above this are superimposed three graphs, showing the varying amounts of iron Fe (green), nickel Ni (blue), and phosphorus P (red). Identify and discuss the material characterization technique and summary on the image. (4)



4) Compare the FEG SEM & conventional SEM instruments with visual mapping. (4)

A)

B) Common table salt is composed mainly of NaCl crystals. In a NaCl crystal, the family of planes are 0.252 nm apart. If the first-order maximum is observed with wavelength of the X-Ray signal is 0.157 nm, what is the incident angle of the X-rays? (2)

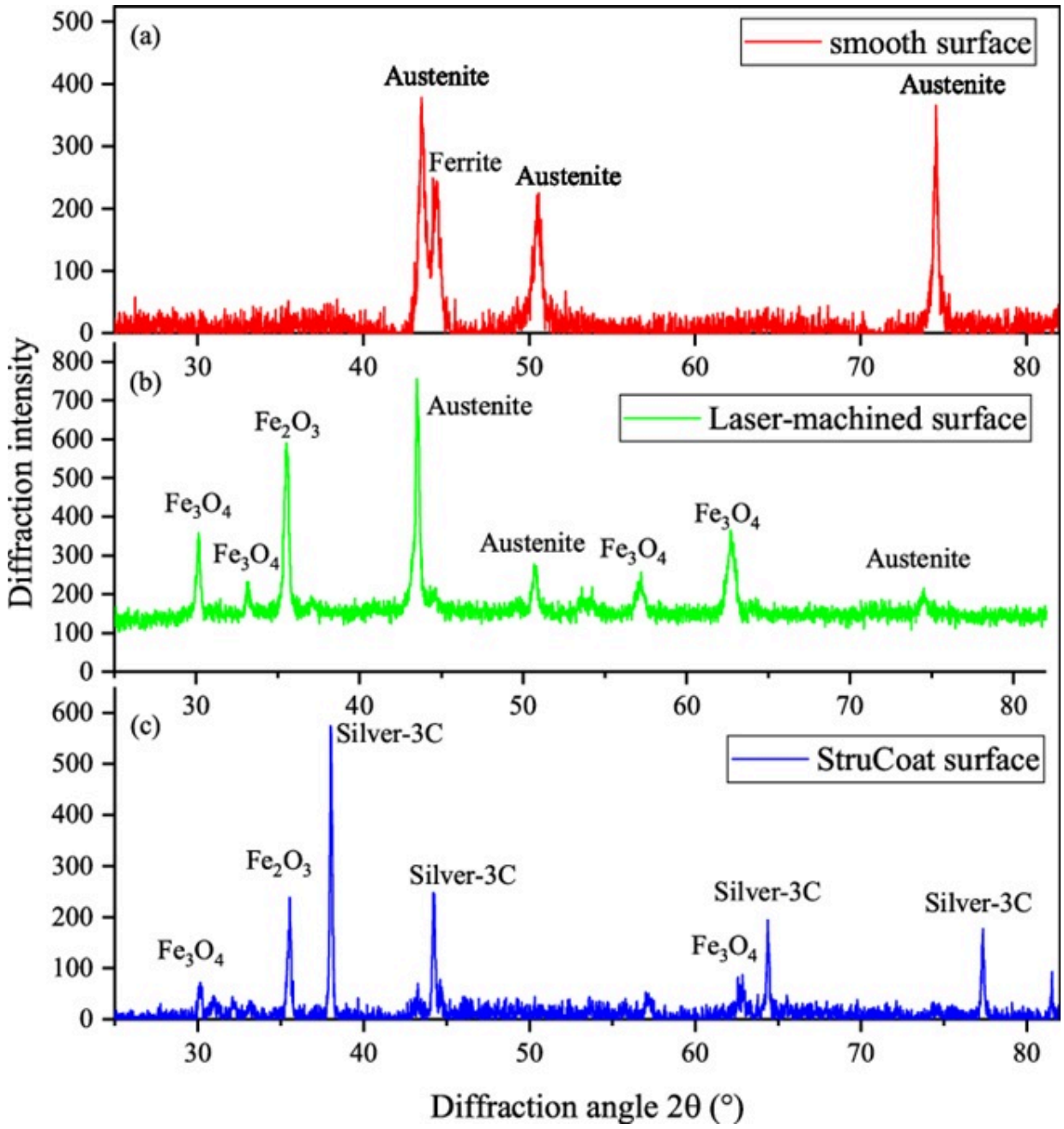
C) Discuss the magnification factor of the SEM instrument. If the image magnification is 40000X and width of the display device is 20 cm, what is the width of the scan? (4)

5) (4)

A) Final semester project work requires studying the effectiveness of joining process characteristics on the steel samples. Which characterization instrument is suitable for the above work? Discuss the sample preparation procedure for that work.

B) Mineralogists would like to verify the material chemistry of the minerals in the field. Suggest a suitable instrument for the work and discuss 2 different types of techniques. (3)

C) Interpret the X-ray diffraction pattern of 316 L stainless steel with reference to Fig (a) smooth surface; Fig. (b) laser-machined surface and Fig (c) StruCoat surface (hybrid fabrication approach which combines laser ablation technology for micro-structuring, and laser-assisted thermal decomposition and deposition for synthesizing and coating AgNPs).



(3)

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