MATE 318

Spring 2025

Homework #6

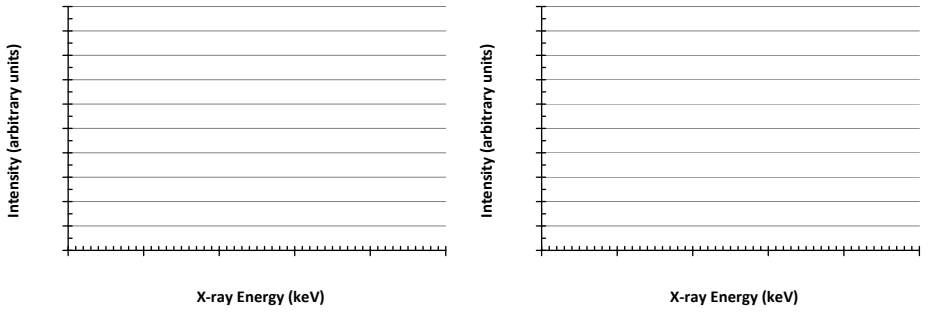
Due: May 30th, 2025

Group submission (up to 3 students per group) is allowed.

Question 1

a) On the figures below, sketch as accurately as you can the K_α x-ray energy spectrum measured with an EDX detector in an electron microprobe for a sample consisting of a homogeneous solder alloy of composition 37 wt.% Pb and 63 wt.% Sn. Assume an electron beam energy of 90 keV was used. State other assumptions you make (if any).

b) How would the spectrum differ if the electron beam energy was 45 keV? Why?



Question 2

EDS counts of two Ti-Al-Nb ternary alloy samples one with a composition of 45 at.% Al and 4 at.%Nb, and the other with unknown composition are given in the table below. Determine the composition of the unknown alloy.

		Ti Kα	Al Kα	Nb Kα
Reference Sample	Comp. (at.%)	51	45	4
	EDS Count	15228	6335	918
Unknown Sample	Comp. (at.%)	?	?	?
	EDS Count	14391	5132	831

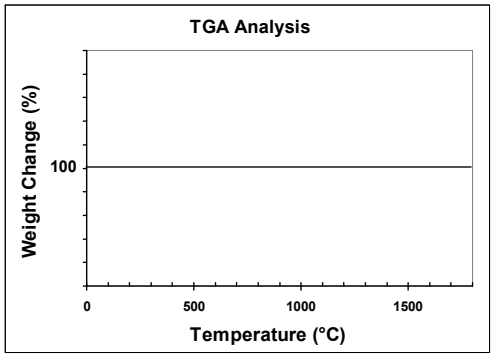
Question 3

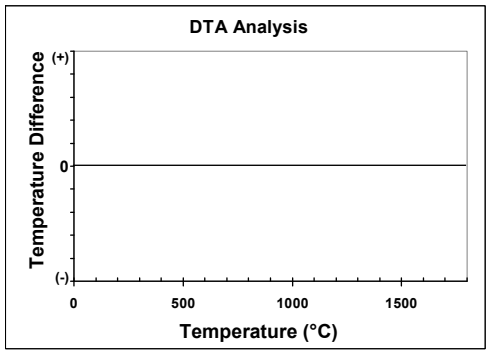
A WDS spectrometer which uses (200) planes of LiF as the analyzing crystal detects x-ray peaks from a sample at 24.31° and 43.02° in θ. Assuming that the detected peaks are Kα peaks, determine which elements are present in this sample.

d(200) of LiF = 0.2015 nm

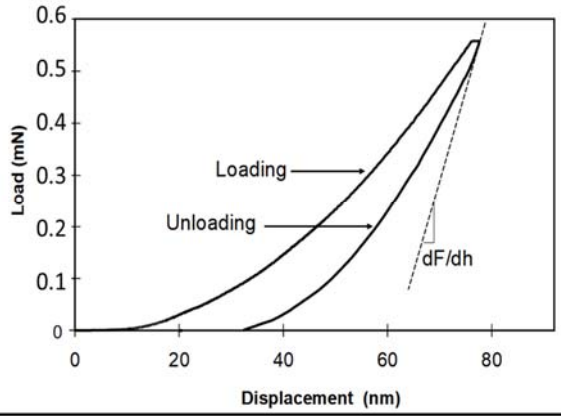
Question 4

A sample of pure iron has been analyzed in ambient air using a combined TGA-DTA instrument with a heating rate of 1°C/min. Schematically draw the TGA and DTA curves you would expect for the temperature range of 0°C-1600°C.





Question 5:

The load vs. displacement curve given below belongs to a nanoindentation test performed on a hard coating using a diamond tip with perfect Berkovich geometry. Find the hardness (H) and elastic modulus (E) values of this coating in GPa.

For diamond take E as 1000 GPa and the Poisson's ratio as 0.06. Take the Poisson's ratio of the coating as 0.21. Take β as 0.75.