

Kelvin Probe Force Microscopy (KPFM) Exam

General

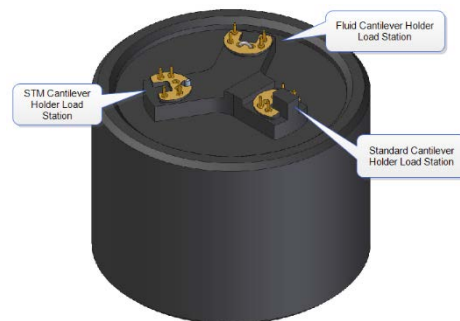
Module(s)

- 1) When would you use the HV KPFM module? Do you need any special accessories if you aren't conducting HV KPFM?

Probe Holder

- 2) Does KPFM require a special (non-standard) probe holder? Why or why not?

- 3) A picture of the probe holder mounting block is shown below. Which of the 3 probe loading stations should be used with the KPFM probe holder and why? Why is it important to check to ensure all 4 metal pins are present and straight (i.e., not bent) prior to *gently* placing the probe holder on the appropriate loading station (i.e., not forcing it onto the pins)?



Probes

- 4) Probe choice is key for successful KPFM measurements.
- a. What is the fundamental requirement for a good KPFM probe?

 - b. What are the relative advantages and disadvantages of the following 3 general types of KPFM probes?
 - i. Pure metal (e.g., Pt)
 - ii. Metal-coated silicon or silicon nitride (i.e., backside plus probe tip coated with metal)
 - iii. Doped silicon with a metal backside coating



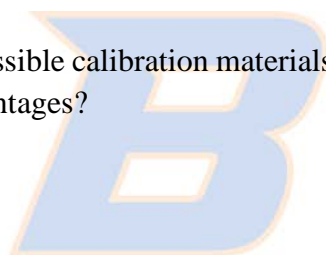
c. What precautions must be observed when using a metal coated probe?

- d. Name at least 5 probes that can be used for KPFM, along with their approximate costs. In general, what is the best probe (i.e., preferred choice) for KPFM? Why?

10) Draw and label a diagram of the KPFM calibration standard.

- a. Which area of the calibration standard is used to calibrate KPFM Volta potentials? Why is this necessary/what does it accomplish? What are the implicit assumptions and potential drawbacks to the method?

- b. What are some other possible calibration materials for KPFM? What are their potential advantages and disadvantages?



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Imaging

11) How do you determine the appropriate lift height to use in KPFM? How can you determine whether or not a feature visible in the KPFM potential channel is a topographical artifact?

12) What are the advantages (and disadvantages) of performing KPFM in a glovebox (or under vacuum) versus in ambient conditions?

13) Describe how you would go about optimizing a KPFM image (e.g., what parameters to adjust, how to determine their best values, etc.).



a. How do you set and check that the KPFM lift mode phase is optimal? How would a non-optimal KPFM phase affect the measured data?

14) What kind of RT (Real Time) and OL (Off Line) fits should you select in NanoScope for the KPFM potential channel?

Data Analysis

15) How does KPFM lateral spatial resolution impact the accuracy of measured Volta potentials?

16) What are some of the ways you can determine the average Volta potential (and uncertainty or standard deviation) of a material or phase from a KPFM image? What are the relative advantages and disadvantages of each method?



17) What are some of the ways you can determine the difference in Volta potential between two adjacent materials or phases in a KPFM image? What are the relative advantages and disadvantages of each method?