

## Nanoindenter – Hysitron TI 950 Measurement Planning

### System Configuration

1. When other than basic system configuration is needed for the measurements, the operator has to be informed about the type of planned analysis and characteristics of measured samples.
2. According to these characteristics, the best available hardware configuration is specified:
  - a. Basic – Nano Indentation head, 1D transducer with Berkovich tip
  - b. Options

Type of analysis	 Nano Indentation Head	 High Load Head	
	Transducer	Probes	Probes
Quasi Static	1D, 2D	Berkovich, Conical	High Load Berkowich
Dynamic	1D	Berkovich, Conical	
Electrical	nanoECR	Berkovich ECR	
Modulus Mapping	1D	Berkovich, Conical	
Scratch Test	2D	Conical	Conical (not available)
Wear Test	1D	Conical	
Heating Stage	1D	xSOL Berkovich	
Fluid cell	1D, 2D	Fluid cell Berkovich	

3. It is necessary to take into account time for system preparation – hardware adjustments and calibrations needed for specific measurement.
4. The user is **not allowed**, under any circumstances, to exchange system parts on his or her own – head, transducer, or probe exchange!

Material interactions with tip at specific temperatures	Dissolves carbon/ Forms carbides	Dissolves carbon at higher temperatures e.g. Fe ~400°C
	Sc, Ti, V, Cr, Y, Zr, Nb, Mo, Hf, Ta, W	Mn, Fe, Co, Ni

5. During measurement with xSOL heating stage, tip interactions with the material of the sample has to be taken into account.

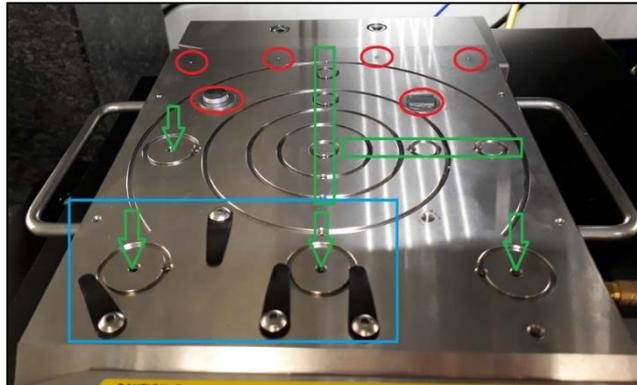
### Sample Preparation

6. The user has to specify the following characteristics of the samples:
  - a. Material
  - b. Size
  - c. Hardness
  - d. Surface roughness
  - e. Thickness of layer
  - f. Sample mount

7. Samples should be well-prepared:
  - a. Surface should be flat with no protrusions
  - b. Surface should be parallel with bottom part of the sample
  - c. Low surface roughness – up to 20 nm RMS. The rule of thumb is that the **surface roughness should be no more than 5% of the depth at which results are required**. Samples with higher surface roughness, or other specific demands, **must be discussed** with the operator for prior analysis. Otherwise there is a high risk of a tip, transducer or piezo scanner damage!

### Sample Mounting

8. There are several possibilities of how to mount the samples. They can be:
  - a. Fixed on metal discs with super glue → can be placed on magnetic parts of the stage (marked in **red**)
  - b. Prepared as blocks with parallel top and bottom sides, or wafers → can be fixed with a vacuum system (marked in **green**). When the vacuum system is on, it is necessary to check if the sample is not moving freely. In case that yes, the bottom surface has to be checked and adjusted.
  - c. Prepared as thin layers on the substrate, or thin sections → can be fixed with clips on the stage (marked in **blue**)



9. It is not possible:
  - a. To embed the samples in the holder of the shape of a cup. When the **edges are higher than the sample** itself, there is a significant risk of transducer damage!
  - b. To fix standard SEM stubs with pins on the stage