

## MINIMUM SPECIFICATIONS FOR VARIABLE ANGLE SPECTROSCOPIC ELLIPSOMETER (VASE)

### 1. INSTRUMENTAL

Must perform at least the following:

- a. Reflection or transmission ellipsometry (E)
- b. Intensity transmission (T) and reflection (R)
- c. Anisotropic ellipsometry and cross-polarized R/T
- d. Depolarization
- e. Scatterometry
- f. Mueller matrix
- g. Spectral range: must be at least between 193 – 2100 nm
- h. Repeatability:       Psi: plus/minus 0.02 degree  
                              Delta: plus/minus 0.1 degree
- i. Accuracy:           Psi: plus/minus 0.03 degree  
                              Delta: plus/minus 0.2 degree
- j. The Angle of Incidence must be computer controlled. Must have range of at least 40 degrees to 90 degrees and accuracy of at least 0.01 degree.
- k. Must include rotating compensator or autoretarder or use phase modulation to ensure measurement accuracy of  $\Delta$  from 0 degrees to 360 degrees.

### 2. SOFTWARE

- a. Must manage modeling recipes including but not limited to measurement parameters, analysis and models and output of results such as nk, statistics, multilayer thickness.
- b. Must include library of tabulated optical constants.
- c. Must support a variety of dispersion models to describe new material optical constants, such as but not limited to:
  1. Graded optical constants (n & k vary at different depths in the film).
  2. Surface and interfacial roughness.
  3. Thickness nonuniformity.
  4. Optical anisotropy (uniaxial and biaxial).
  5. Effective medium approximation (EMA) to mix up to 3 materials.
- d. Must perform regression on measurements.
- e. Must produce output graphs and save the results files (at least but not limited to mapping and statistics).
- f. Must perform at least instrument setup, self tests and spectrometer calibration.