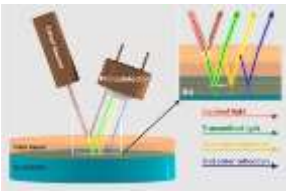
APPLICATION NOTE #021

In situ Characterization of Photoresist film development



Introduction: Characterization of photoresist dissolution process has been continuously investigated aiming the optimization of pattering processes for future semiconductor and photonic devices. Real-time monitoring of the dissolution can provide the essential information needed for such characterization. In this application note, real-time monitoring of the dissolution process of a resist (AR-N7520.18) film in standard developer (AZ726MIF) is being demonstrated by using **FR-Basic Vis/NIR** and **FR-Liquid** accessory.

Means & Methods: The sample under investigation was a Si wafer spin coated with an AR-N7520.18 resist film. AR-N 7520 is a commercial high resolution negative e-beam resist by All Resist[1]. The characterization was performed by an FR-Basic Vis/NIR operating in the >400nm spectral range, in order to avoid exposure of the resist film during the characterization, and the FR-Liquid kit.
FR-Liquid is an accessory for the real time monitoring of changes, e.g. **swelling** or **dissolution**, in **thickness** and **optical constants** (n&k) of thin/thick films during processing in liquids. It consists of a PTFE (Teflon) cell and a holder to accommodate the sample under test. PTFE, due to its properties (hydrophobic, chemical and thermal resistant) make suitable the use of FR-Liquid for a wide range of liquids. Optical measurements with the FR-Basic tool are possible due to the optical window design on the cell.

Results: In *Figure 1*, the recorded reflectance spectrum is illustrated along with the fitted one. The environment is set to the developer properties and the fitting is very good despite the fact that the reflection probe is mount outside the vessel. This configuration allows the usage of any developer, since it establish the non-contact of the reflection probe with the liquid. At the same time, the horizontal mounting of the reflection probe and the vertical orientation of the sample under test allows for fast insertion of the sample into the developer and recording of high intensity interference extrema. For very thin layers it is suggested to use as substrate Si wafer with dielectric layer of adequate optical thickness e.g. >500nm SiO_2. In *Figure 2*, the evolution of the resist film thickness, non-irradiated areas, is illustrated. Similar results can be also recorded for positive resists or any transparent or semi-transparent polymer coating.

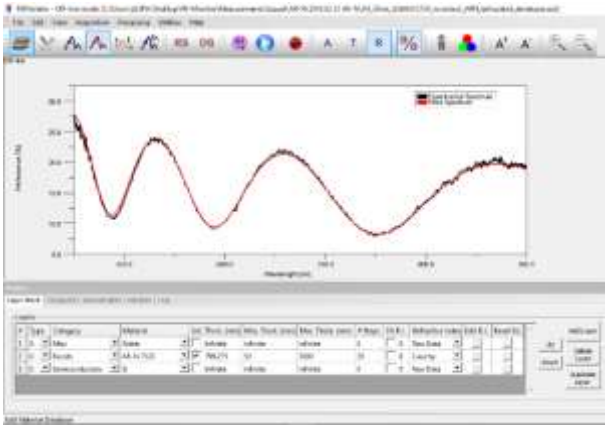


Figure 1: Reflectance and fitted spectra from an 800nm thick resist film on Si wafer immersed in AZ726MIF developer.

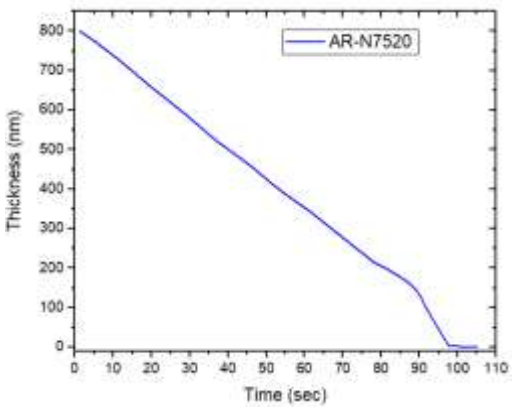


Figure 2: Dissolution measurement of AR-N-7520.18 resist

[1] http://www.allresist.com/wp-content/uploads/sites/2/2016/12/allresist_produktinfos_ar-n7520_englisch.pdf