

## Analysis of High-Precision TMAH Developer Solutions

**In meeting today's integrated circuit design specifications, resist development is a critical process that must be controlled to minimize critical dimension variation.** Tetramethyl ammonium hydroxide (TMAH) is a long-used developer in this process, and tight control over TMAH developer specifications has been in use for many years. Current specifications for TMAH are in the 0.2 to 0.3 Normal concentrations (~2.2 to 2.4 % (w/w)), with the variability approaching +/- 0.0005 N. As specifications and required precision are always becoming more stringent in the semiconductor industry, Balazs has developed best-in-class chemical titrations to assure customers that their TMAH developer is in specification and in control for developer concentration.

Although we start with a simple acid-base titration, the analysis of these developer solutions with "ultra-tight" specifications is not straight-forward. First to consider is the choice of a standard with minimal uncertainty in its concentration. No NIST-traceable TMAH solution exists as a standard reference material for comparison, and hence **a proper choice for primary and/or secondary standardization is commonly required.** In addition, conventional acid-base analyses with manual burets will have an uncertainty of at least 0.01 mL. Such uncertainty in titrant volume can push the uncertainty in the measurement to +/- 0.0005 N, i.e. at times the width of the entire specification. Automated titrators, far more often the norm for this type of analysis, also have uncertainty, and combined with the uncertainty imparted from different steps in the analysis scheme must be understood to ensure analysis results can be properly judged versus the manufacturing process as well as the customer specification.

Second, semiconductor companies along with simple Gaussian statistics and common sense require measurement precision to be much tighter than an actual chemical specification. This allows the analysis imprecision to not over-whelm variability in the actual chemical product. Moreover, adequate measurement capability allows proper analytical granularity to observe minute changes in TMAH concentration that could fall out of a control specification and affect the process.

Although uncertainty will always be present in every analysis, Balazs scientists understand their sources and have incorporated techniques with proper sampling, sample handing, and **standards used for analysis** to ensure analysis and measurement process capability is appropriate for the tightest TMAH specifications. If absolute developer concentration or developer concentration drift is in question at a fab, Balazs has the metrology in place to provide both accurate and precise results.

**For additional information, please contact [us](#).**