



1. Title:	Development of Low Thermal Expansion Materials and CTE measurement tool for EUVL
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3. Abstract body:

Ti-doped silica glass ($\text{TiO}_2\text{-SiO}_2$ glass), which is well-known as low thermal expansion material (LTEM), used in EUVL must have an ultralow coefficient of thermal expansion (CTE) on the order of $10^{-9}/\text{K}$. On the other hand the resolution of commercial dilatometers is not high enough to measure precise CTE properties of LTEM. Therefore it is difficult to evaluate CTE of LTEM and to optimize for EUVL. So, ASET has developed an optical heterodyne interferometric dilatometer tailored to meet EUVL requirements. And ASAHI GLASS has optimized the CTE of its Ti-doped silica glass to achieve the SEMI's specification. Consequently, the newly developed dilatometer showed that the repeatability (σ) was 0.80 ppb/K and the resetability was ± 0.85 ppb/K. We confirm this dilatometer is useful for precise measurement of the CTEs of EUV-grade LTEMs. Further we evaluated the CTE of Ti-doped silica glass using this dilatometer, and we demonstrated that the CTE of Ti-doped silica glass at room temperature is in proportion to TiO_2 concentration. We optimized the CTE based on this proportional expression and we confirmed that the CTE of our LTEM was 1.1 ppb/K.