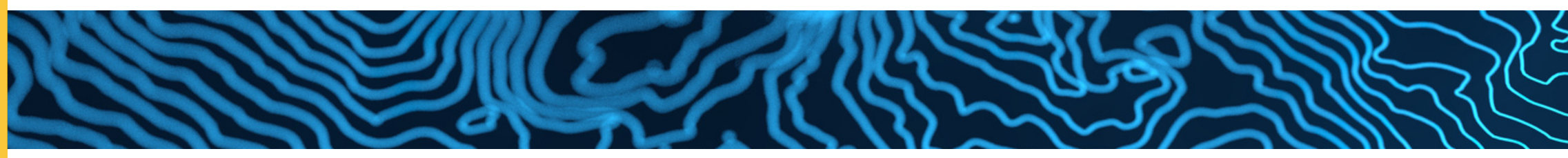
CTE Measurement with TDM Systems

The importance of microelectronics matching the materials and Coefficient of Thermal Expansion (**CTE**) as closely as possible is essential. However, a significant mismatch can result in electrical failure or component damage due to the forces exerted as the encapsulant expands or contracts with temperature changes, resulting in circuit failure.
Producing **CTE** results with our TDM compromises precise temperature control and measurement/displacement.
Our test chamber has five independent heating zones and fifteen cooling air inlets for tight dynamic control. This design gives us highly controlled temperature homogeneity on the samples.



Registering the measurement is carried out using our 3D + Projection Moiré and 2D-DIC.
While doing the CTE measurement, our TDM system generates files containing a 3D topography map with a matrix of coordinates on X, Y, Z, and a grey scale imaging. These coordinates will serve as tracking zones. We break down the area into smaller sets for the displacement measurement. The 2D-DIC allows the tracking of the smaller individual subsets.
(Capable of exporting the displacement results as vector plots, CSV, or jpg).
Our dependency for CTE accuracy lies within the DIC tracking, pixel coverage, and temperature (homogeneity, surface, and inner temperature).

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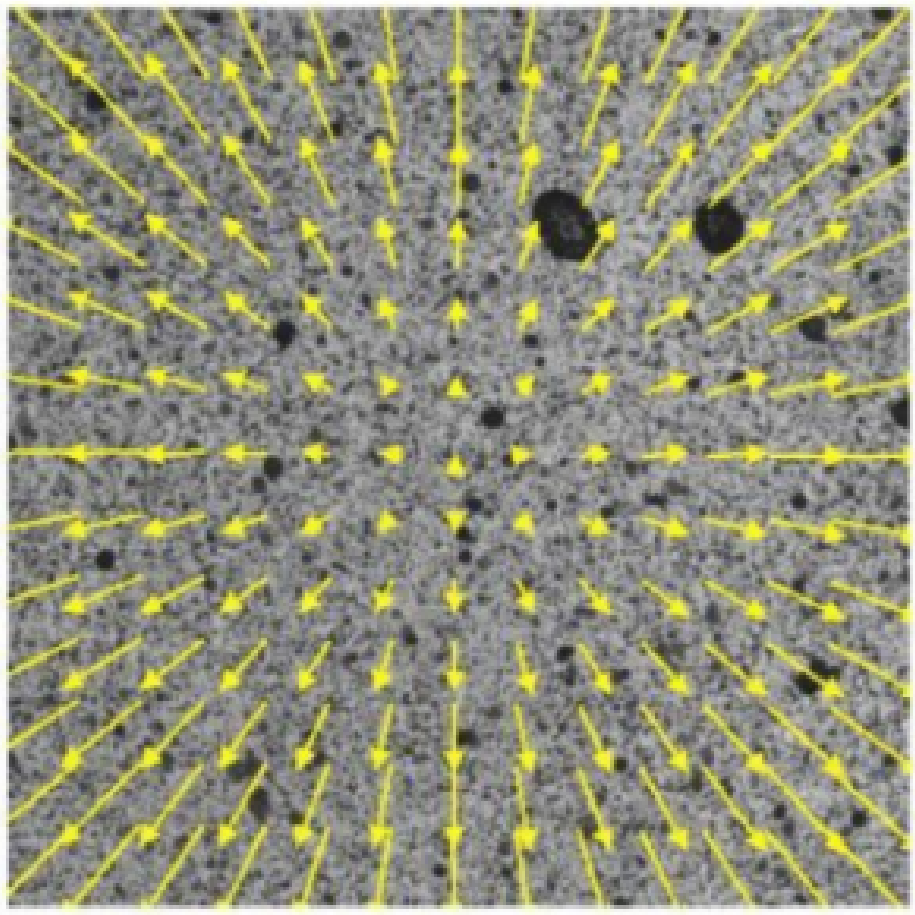
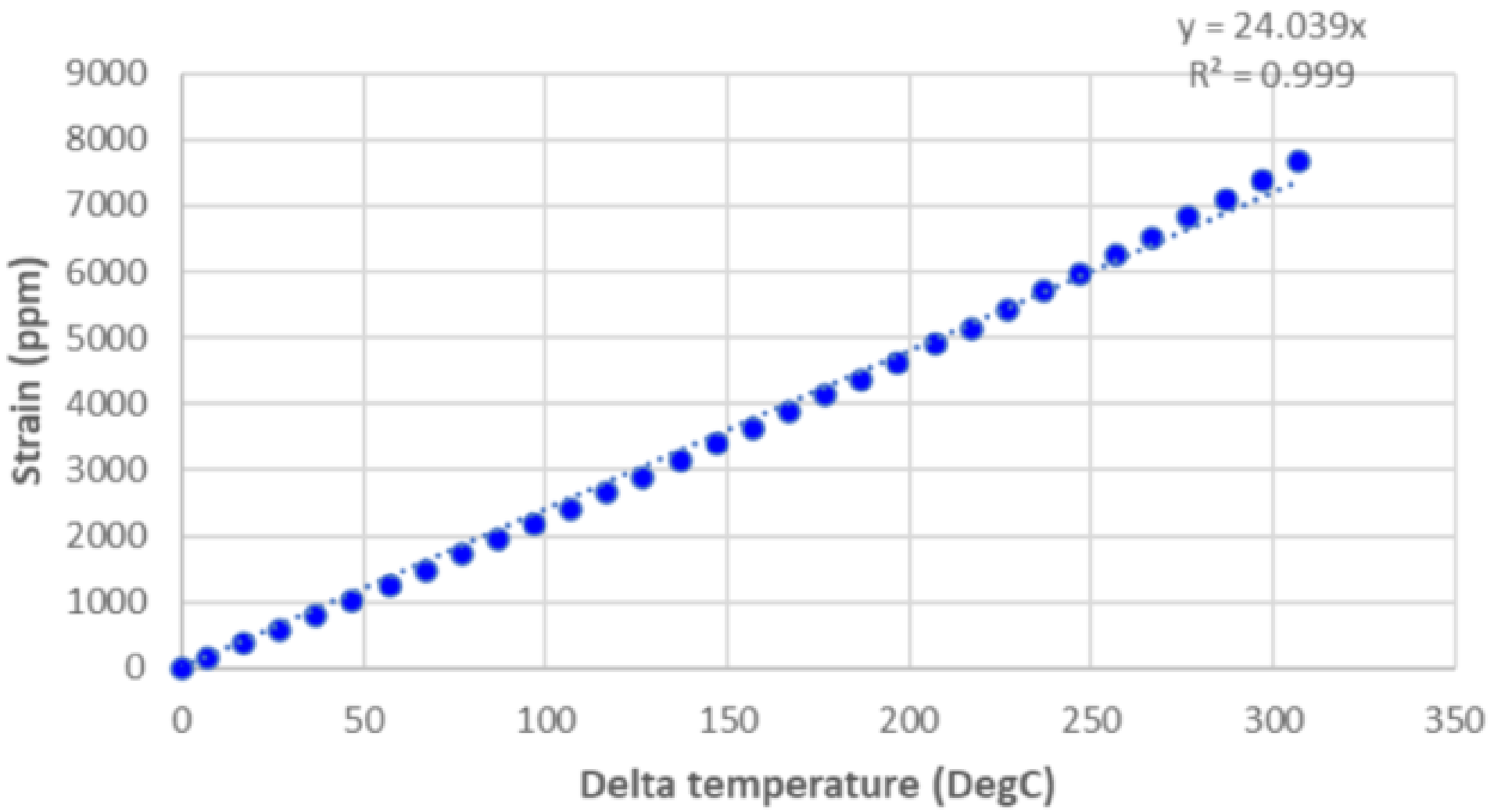
Characterization by Vector Plots



CTE = 16.7 PPM/K Avg Displacement Norm = 573.4µm
#13 T° = 251.7°C Delta T° = 222.85°C

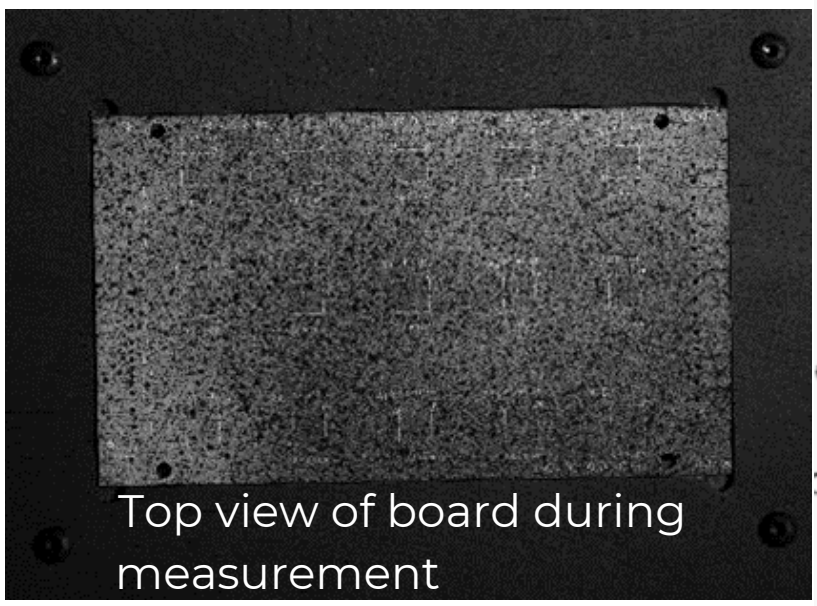
Strain Plots



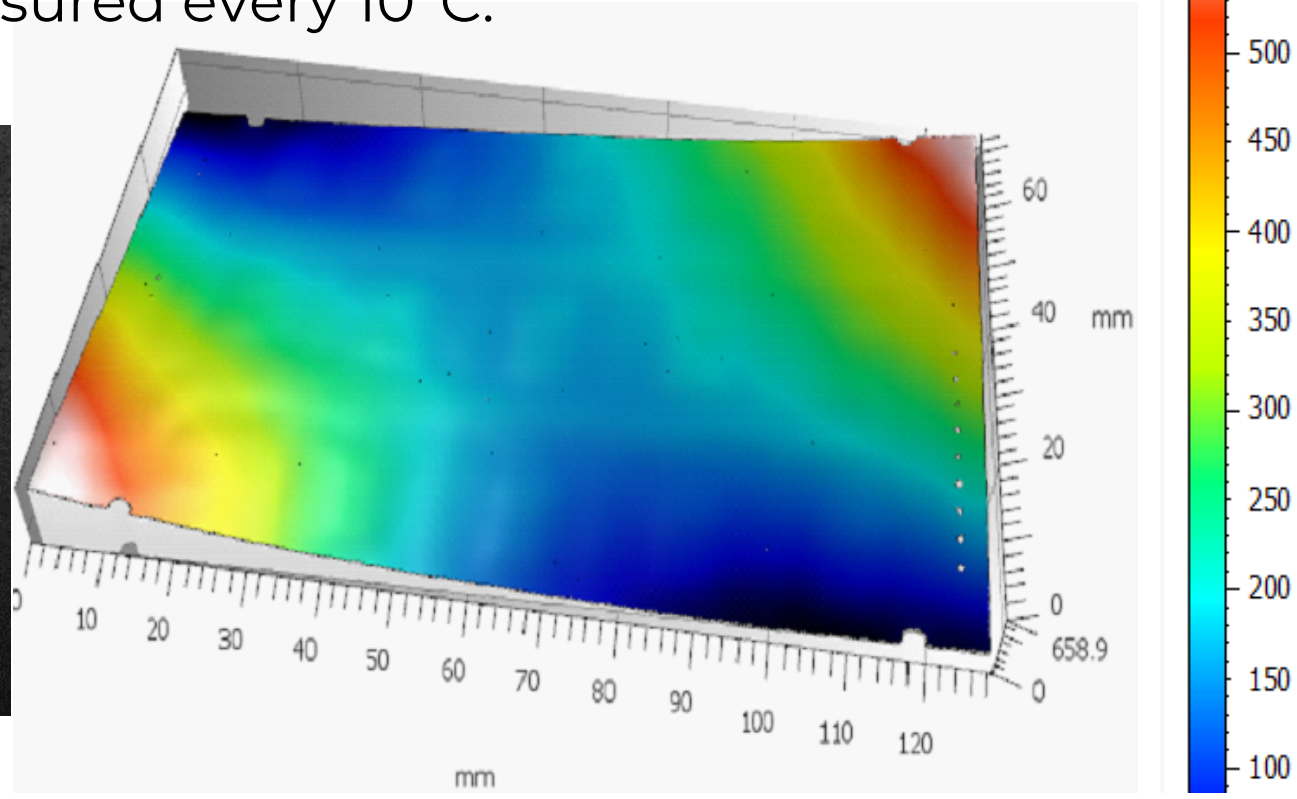
CTE Application Study

Material characterization during -65 ~ 260°c thermal profile

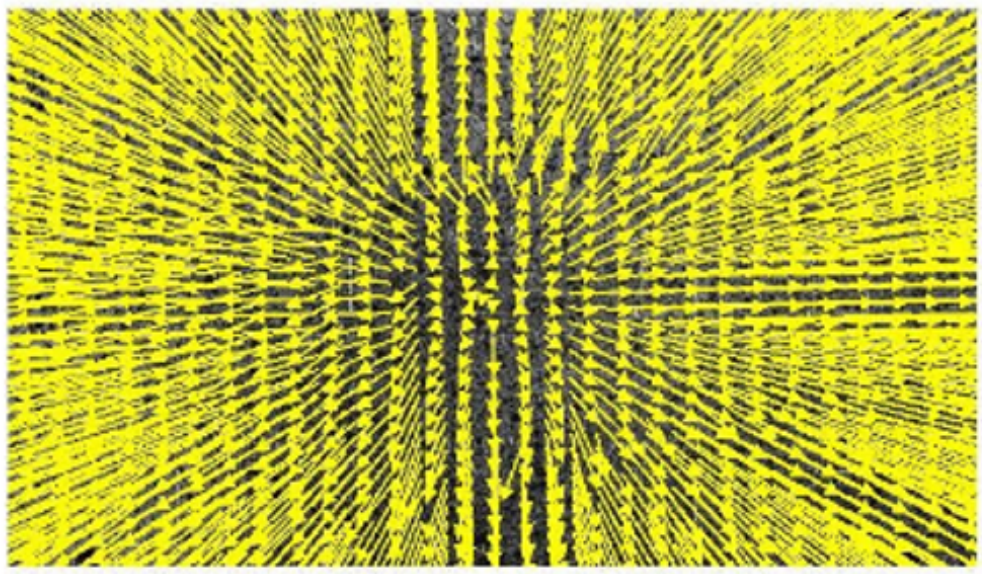
Since it is possible to measure at the same time the CTE and warpage, TDM is often used for material characterization and to provide warpage and strain information during the same thermal profile.
In the example hereunder, a material was characterized during a profile starting at -60°C and heating sample up to 265°C
CTE and warpage were measured every 10°C.

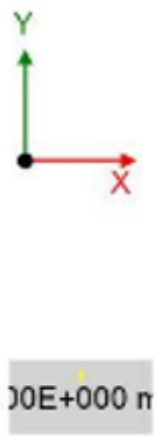


Top view of board during measurement

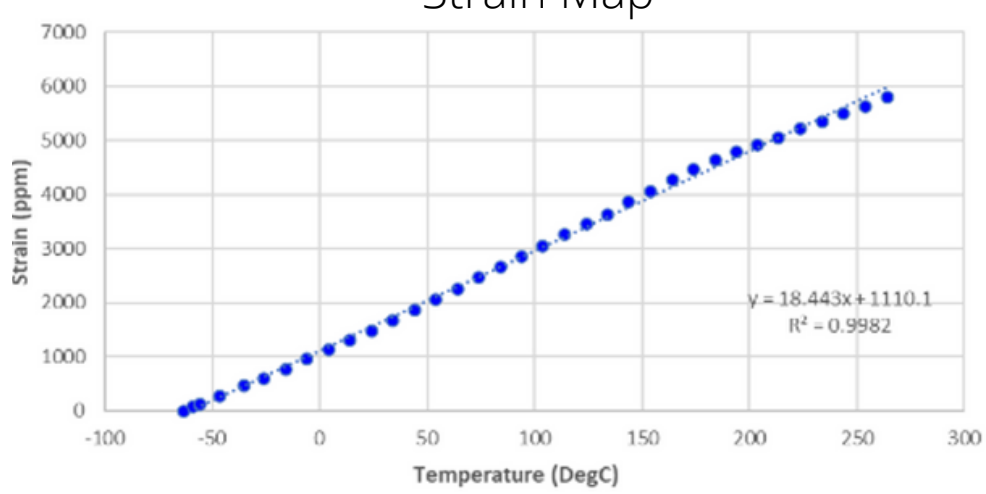


3D shape of board measured by TDM





Strain Map



CTE = 18.1 PPM/K Avg Displacement Norm = 373.5µm
#30 T° = 223.75°C Delta T° = 287°C

Displacement vector at 223°C
Averaged CTE during the profile was 18.4 ppm/K

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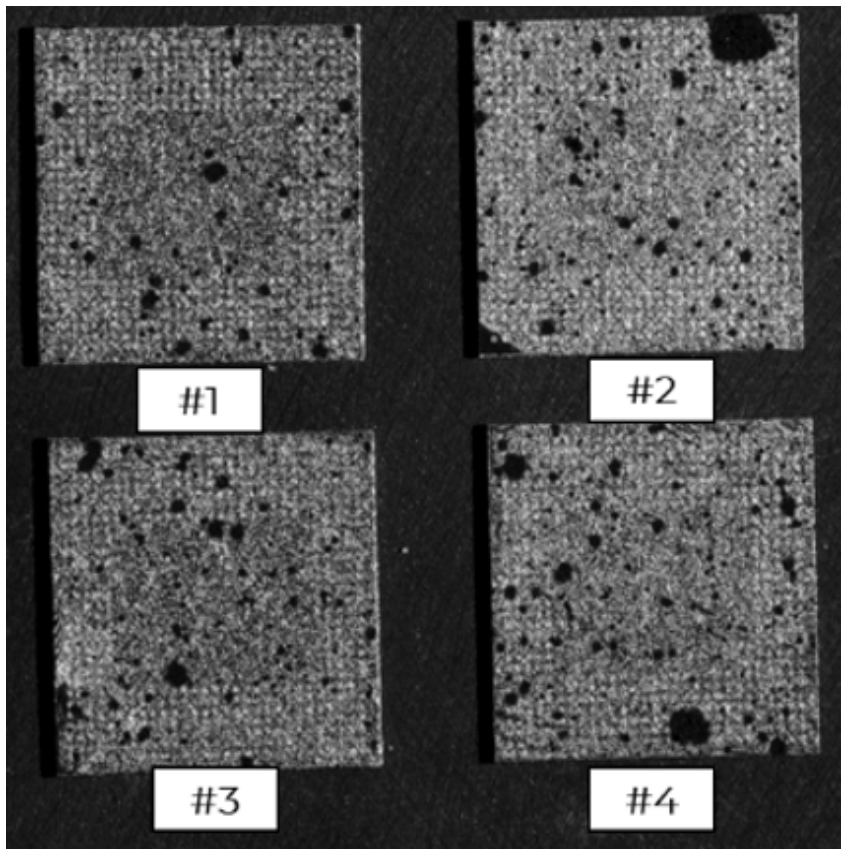
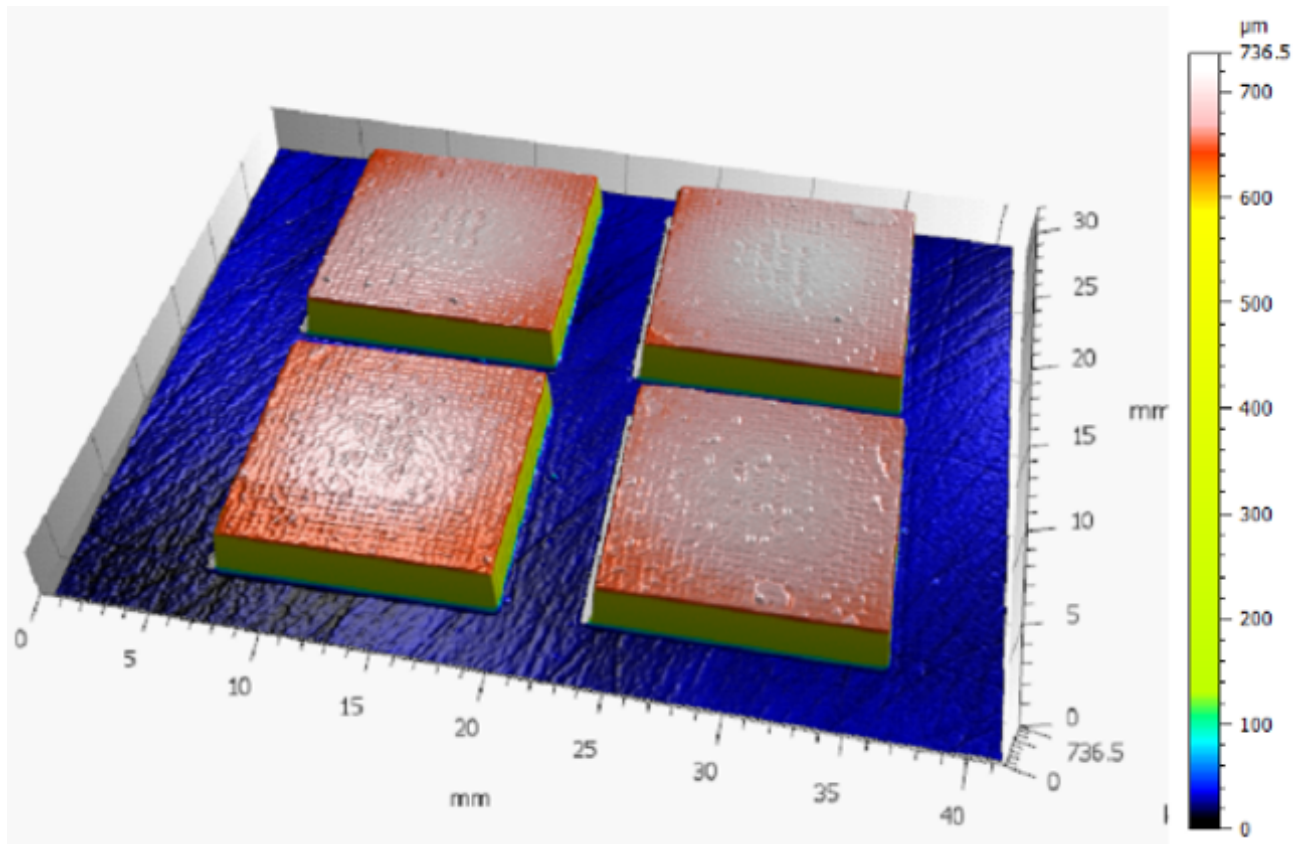
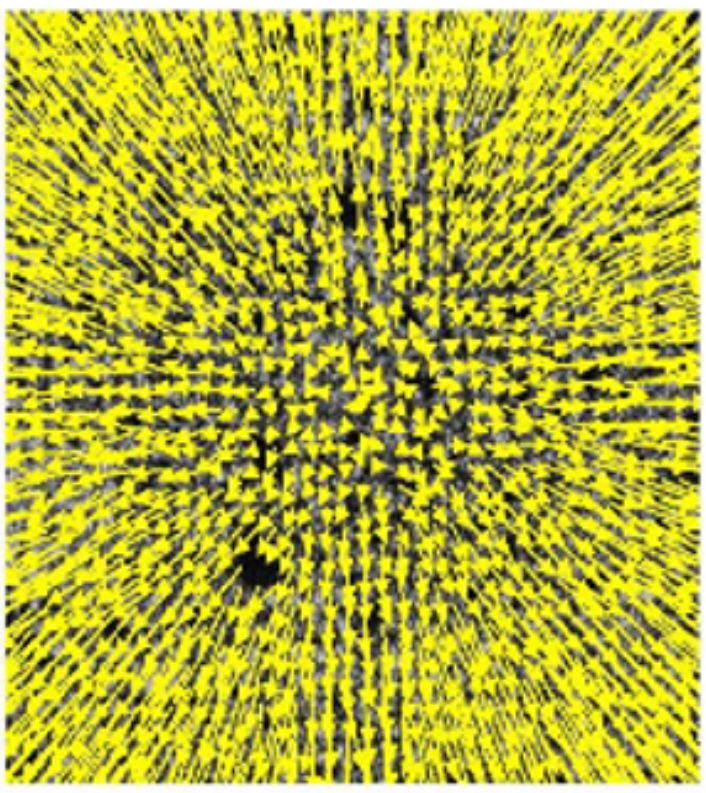
CTE Application Study



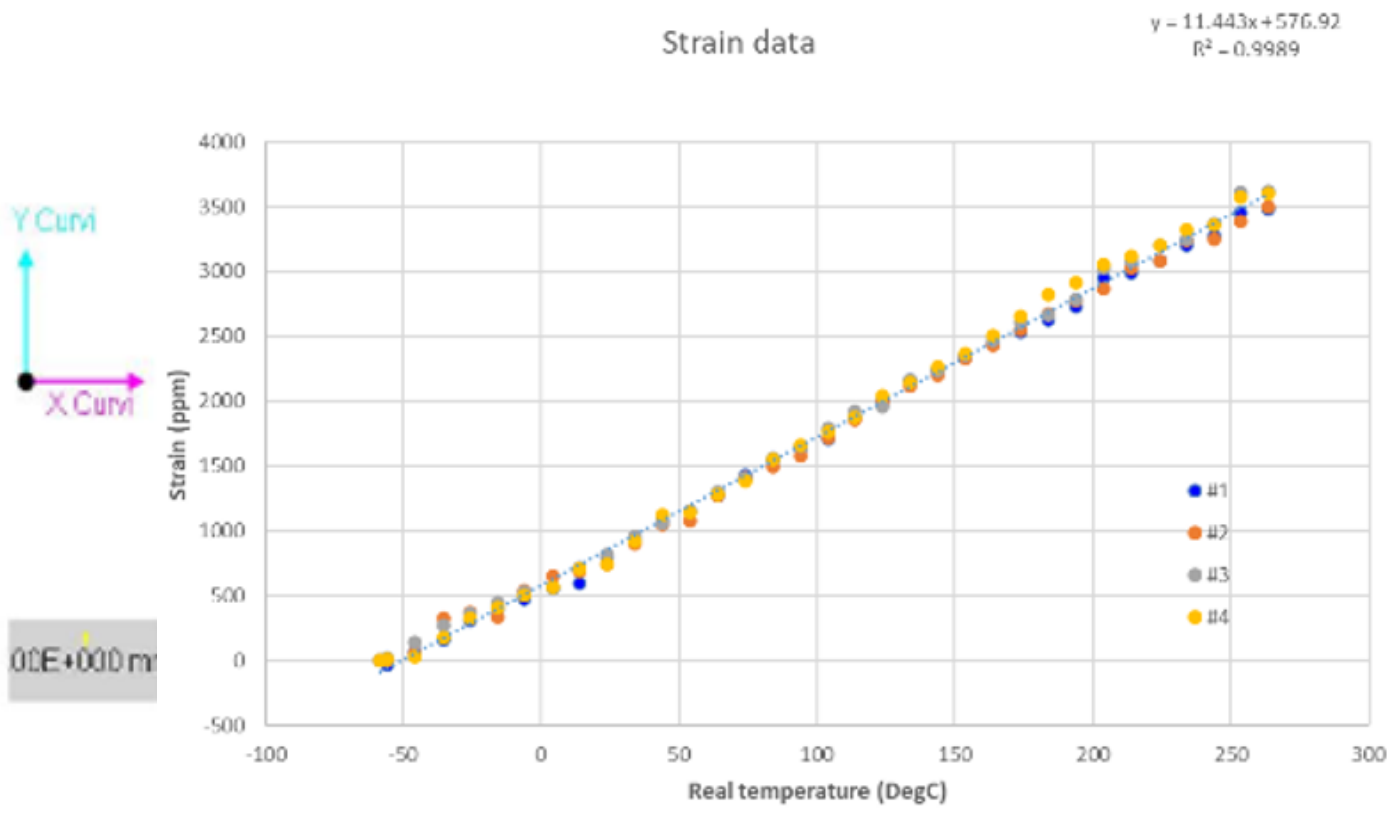


#3



CTE = 11.4 PPM/K Avg Displacement Norm = 84.2µm
#34 T° = 263.6°C Delta T° = 321.95°C

Strain Plot for all 4 substrate



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