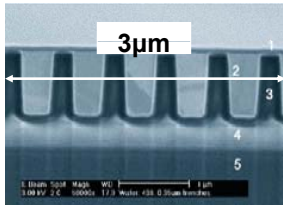
LOMSS

Nano-Pattern Recognition and Correlation (N-PRC) Technique



www.micromagazine.com/archive/99/10/han.html

Cross section of a single-layer copper damascene structure with low-k film after trench fill. (1 = cap layer, 2 = copper, 3 = low-k film, 4 = etch stop, and 5 = silicon substrate).

- Objective: To develop a displacement measurement technique for nanoscale structures
- Technical requirements: Measurement sensitivity on the order of ***fraction of nanometer*** on a ***sub-micron length scale***.

Specific tasks include:

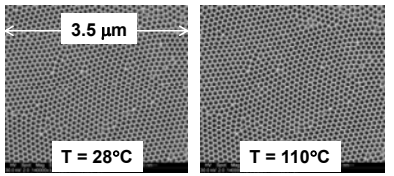
- Fabrication of nano-pattern mask using a customized nano-hole template
- Area E-beam lithography to fabricate nano-scale PMMA patterns on specimen surface
- Novel image processing algorithm to document the deformation

Nano-Pattern Recognition and Correlation Technique (N-PRCT)

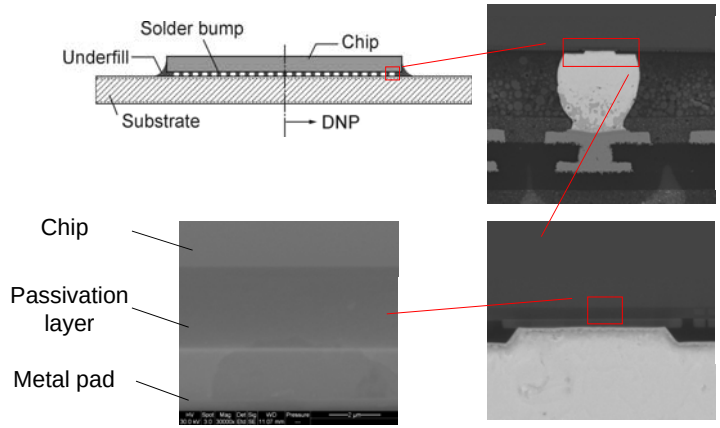
- The method uses ***regularly oriented*** nano-scale structures that are fabricated on the surface of the specimen.
- Special benefits accrue from the regularity, relative to the random markings used for the existing techniques. N-PRCT will be used to overcome the practical limitations of DIC.
- The fundamental concepts of pattern recognition and correlation are subsequently employed to determine the deformation fields.

Amplitude Measurement

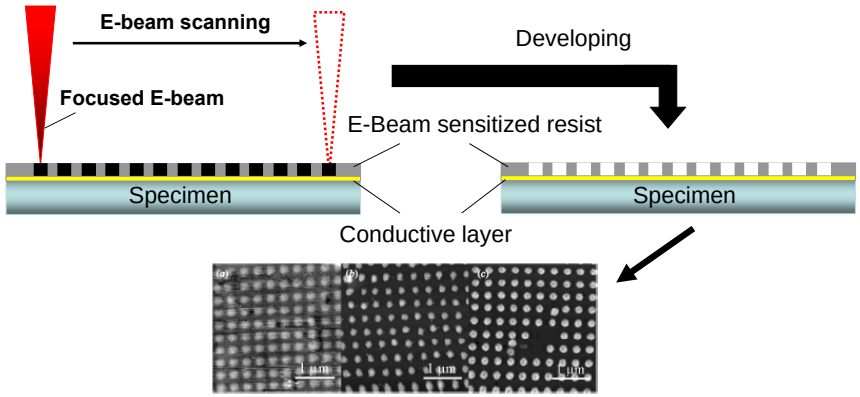
Nano-template before and after thermal loading



Specimen and Region of Interest

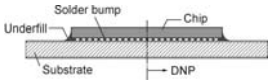


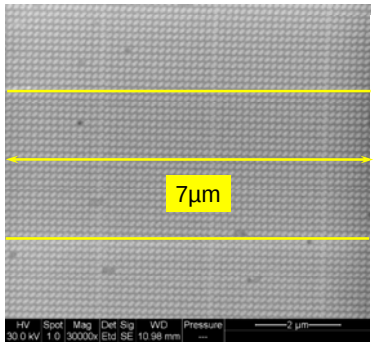
Schematic Illustration of E-Beam Lithography to fabricate regular pattern

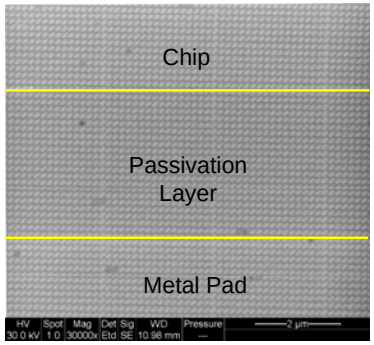


[68-69]

Nano Patterns Fabricated on the Region of Interest

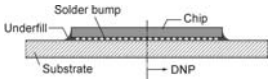


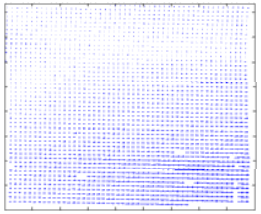




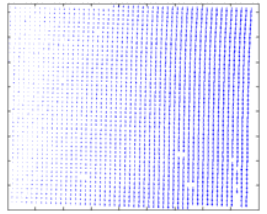
T = 23°C T = 108°C

Displacement Plot





Discrete displacement



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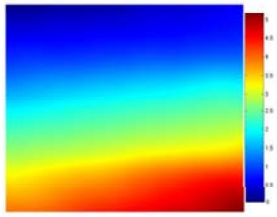
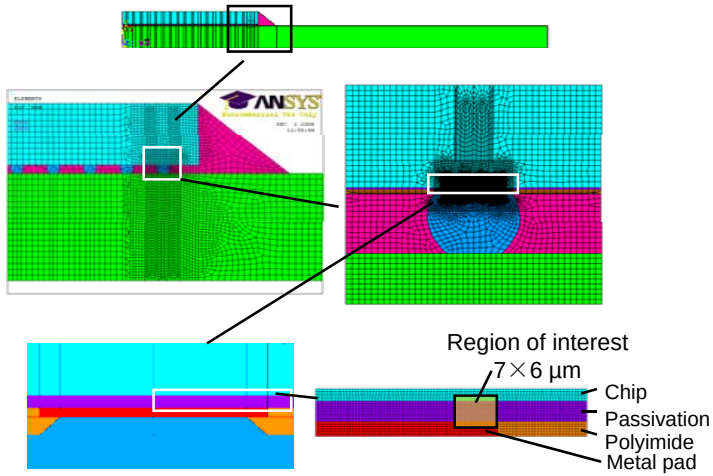


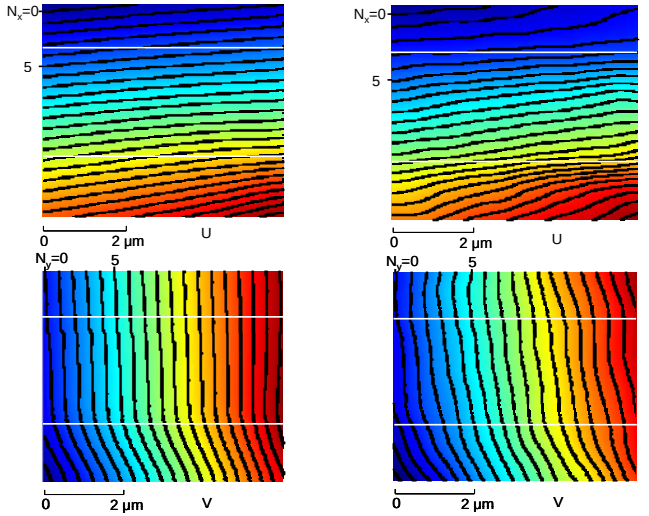
Continuous displacement

Numerical Validation



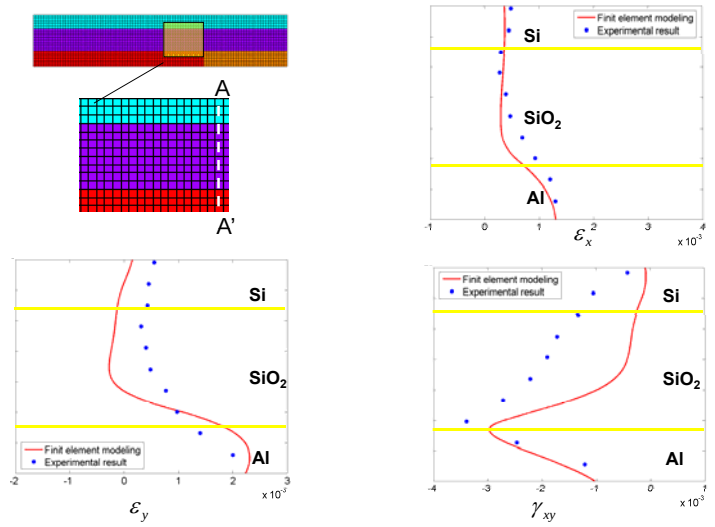
Finite Element Modeling

Numerical Validation



Finite Element Modeling Result Experimental Result

Numerical Validation



ε_x ε_y γ_{xy}