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RESIDUAL STRESS IN ALUMINIUM
MATRIX COMPOSITES

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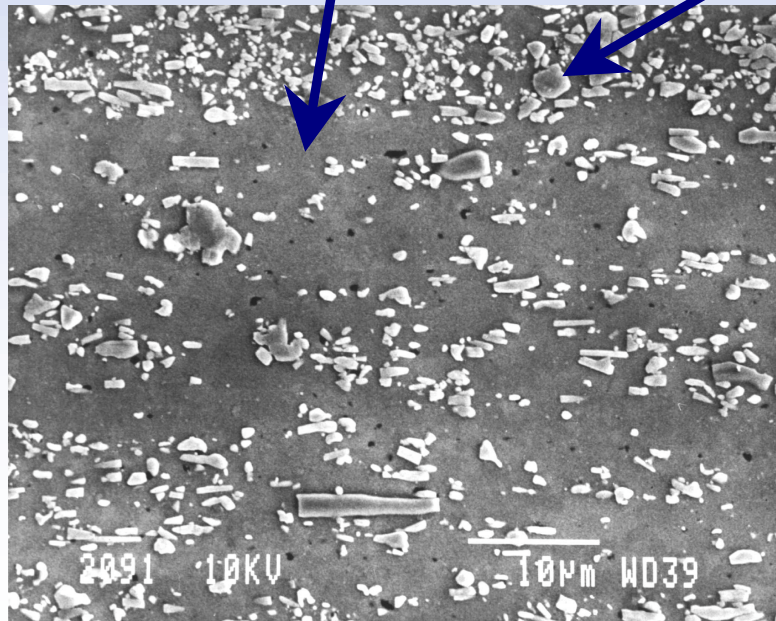
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COMPOSITES

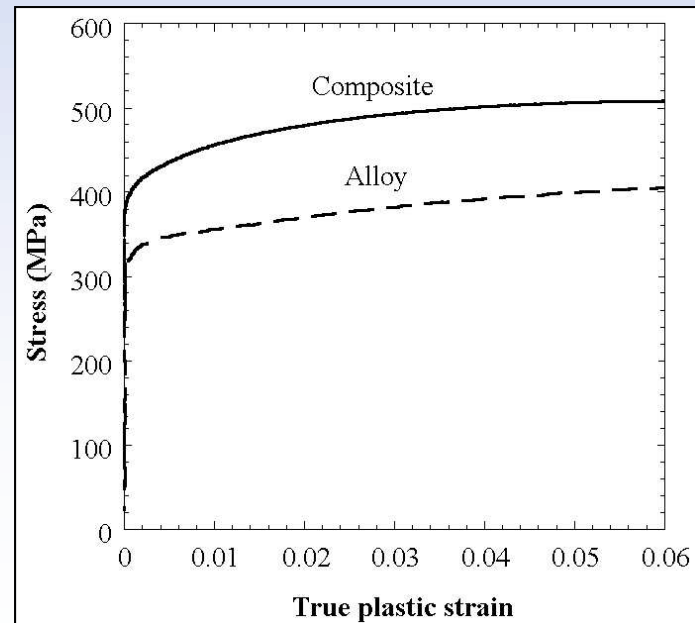
MATRIX

ALUMINIUM ALLOY
(AA6061, AA2014)



REINFORCEMENT

CERAMIC PARTICLES/WHISKERS
(Al_2O_3 , SiC)



RESIDUAL STRESS

**STRESS LOCKED
WITHIN THE MATERIAL**

- *WELDING*
- *INHOMOGENEOUS PLASTIC DEFORMATION*
- *INHOMOGENEOUS HEAT TREATMENTS*

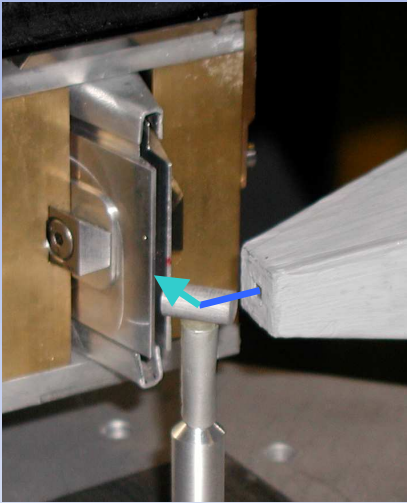
COMPOSITES

Macro Stress

Micro Stress

*Mismatch
matrix/reinforcement
Differences in CTE*

THE METHOD: NEUTRON DIFFRACTION



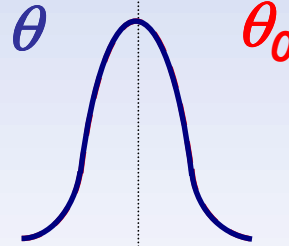
Bragg's Law $2d \sin \theta = n\lambda$

Strain

$$\varepsilon = \frac{d - d_0}{d_0} = -\cot \theta_0 \Delta \theta$$

Sample

Stress free reference



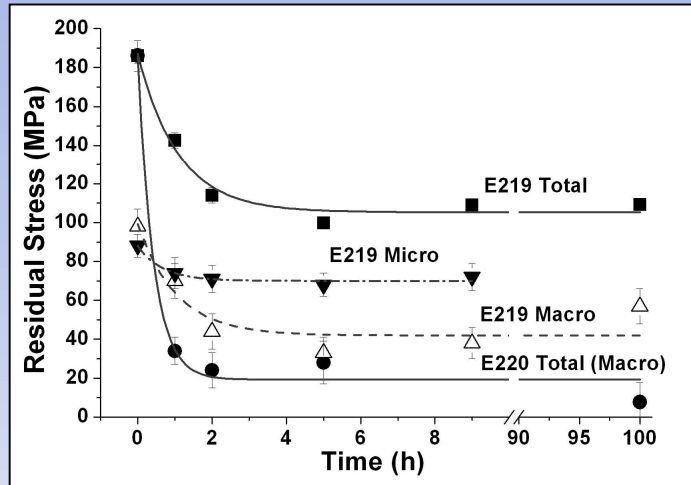
Stress

$$\sigma_i = \frac{E}{(1 - 2\nu)(1 + \nu)} \cdot \left[(1 - \nu)\varepsilon_i + 2\nu(\varepsilon_j + \varepsilon_k) \right]$$

Hooke's Law

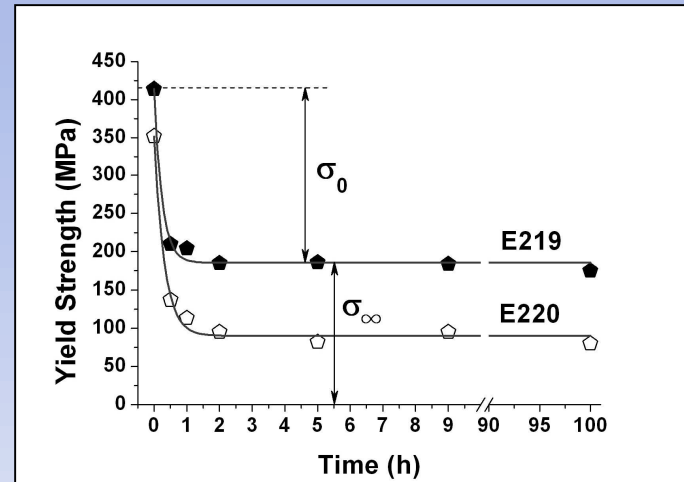
SOME RESULTS

Residual Stress Relaxation



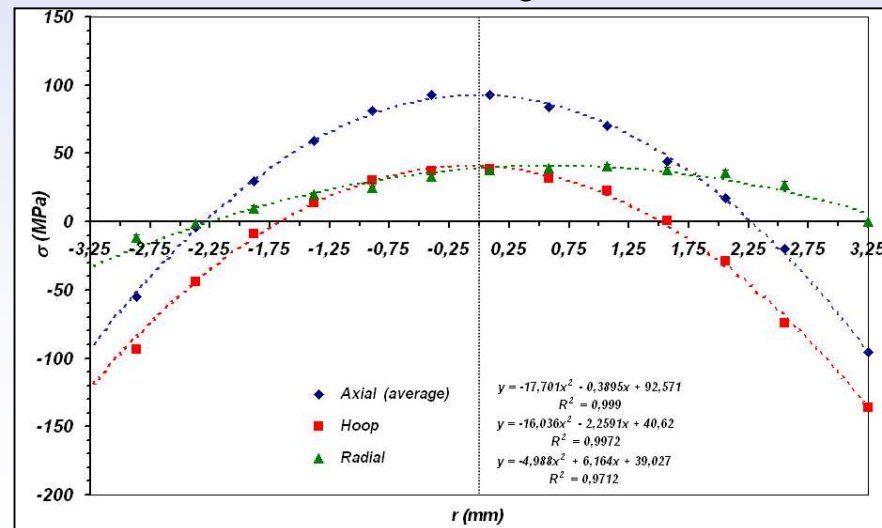
(D1A, ILL)

Yield Strength Relaxation

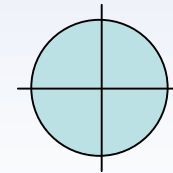


(CENIM)

Stress Profile



Cross Section,
cylinder



(ID31, ESRF)

GOAL

STUDY OF VARIABLES →

- *Heat Treatment*
- *Plastic Deformation*
- *Matrix Composition*
- *Reinforcement Composition*

RESIDUAL STRESS

↙
RELAXATION

↘
DISTRIBUTION

TO OPTIMIZE FABRICATION PROCESSES