



# 2022「中技社科技獎學金」

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## 研究獎學金

Research Scholarship

### 藉由理論、模擬、實驗探討基材-異質複合材料之破壞分析

## Failure Analysis of a Matrix-Inclusion Composite

### by Theory, Simulation, and Experiment method

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### 研究重點

The research for this problem consists of two parts. In the first part, the failure behavior of an arbitrarily shaped hole with inclusion located at the matrix under elastic or thermoelastic boundary conditions is considered by the theoretical method. Based on the method of analytical continuation with alternating technique, complex variable, and conformal mapping method, the temperature contour or interfacial stress can be solved. To examine the realist situation, the second part presents multiple arbitrarily shaped inclusion in the matrix by coupled experiment and simulation. Hence, the Transformation Induced by Plasticity (TRIP) steel composite reinforced with 5% Vol-% ceramic particle is studied.

### 研究成果

	Theoretical Method				Experiment and Simulation Method			
	Elastic and Failure Analysis of Matrix, Inclusion, Hole				Plastic and Failure Analysis of Matrix, Inclusion			
<b>Problem Statement</b>	<b>Experimental Observation</b> 	<b>Physical Plane</b> 	<b>Mathematics Plane</b> 	<b>Boundary Condition</b> Dislocation Point Load Inplane Crack Antiplane Crack Point Heat Source Heat Flow	<b>SEM</b> 	<b>TRIP-Steel Sample</b> 	<b>In-Situ Stage</b> 	<b>Initial micrograph</b> 
<b>Method</b>	<b>Complex Variable</b> $2G(u_x + iu_y) = \kappa\phi(\zeta) - \frac{m(\zeta)}{m'(\zeta)}\overline{\phi'(\zeta)} - \psi(\zeta)$ $-F_y + iF_x = \phi(\zeta) + \frac{m(\zeta)}{m'(\zeta)}\overline{\phi'(\zeta)} + \psi(\zeta)$	<b>Conformal Mapping</b> $z = m(\zeta) = (\zeta + \frac{w}{\zeta^n})$ $n=2$ $n=3$ $n=4$	<b>Analytical Continuation</b> Outside $\phi_b(\sigma) + \omega_b(\sigma) + \phi_{in}(\sigma) + \omega_{in}(\sigma) = \phi_{in}(\sigma) + \omega_{in}(\sigma)$ $\frac{1}{G_2} [\kappa_1 \phi_b(\sigma) - \omega_b(\sigma) + \kappa_2 \phi_{in}(\sigma) - \omega_{in}(\sigma)]$ Inside $\phi_{in}(\sigma) + \omega_{in}(\sigma) + \phi_b(\sigma) + \omega_b(\sigma) = 0$	<b>Crack Treatment</b> Dislocation Density Singular Integral Equation Gauss-Chebyshev Integration Stress Intensity Factor 	<b>Interface Identification</b> 	<b>Grain Orientation</b> 	<b>Digital Image Correlation</b>  0-6.4%	<b>Cohesive Element Method</b> 
<b>Result</b>	<b>Heat Flow</b>  Temperature Contour	<b>Heat Source</b> 	<b>Dislocation</b>  Climbing Image Force	<b>Inplane Crack</b>  Stress Intensity Factor	<b>Experimental Result (VEDDAC)</b>  0 % 40	<b>Simulation Result (ABAQUS)</b>  NCE CE	<b>Damage Validation (MATLAB)</b>  Sim. Exp. 75 μm	

### 研究生活及心得

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