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<table>
<thead>
<tr>
<th></th>
<th>a. REPORT</th>
<th>b. ABSTRACT</th>
<th>c. THIS PAGE</th>
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</thead>
<tbody>
<tr>
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</tbody>
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<table>
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<tr>
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<th>A</th>
<th>17</th>
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</thead>
</table>

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SEM Study of Deformation and Failure Mechanisms in Strained Elastomers

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Objectives

- Investigate the deformation and failure mechanisms on meso and macro scales in a particulate composite and Solithane 113.
- Determine the strain fields on the meso and macro scales of the two materials.
Testing Set-Up

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Local Damage at Crack Tip

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\( \varepsilon_x \) for 11.34 psi at 30 sec
$\varepsilon_y$ for 11.34 psi at 30 min
Maximum Principal Strain Distribution of 6.0% Far Field Strain During Loading
Maximum Principal Strain Distribution of 8.0% Far Field Strain During Loading
Side View of Crack Tip at 40x.

07/13/2002

40.0x 500um

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Side View of Crack Tip at 150x, 400x, 500x, and 1000x.
SEM Pictures of Top View of Crack Tip at 150x and 250x.

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Strain Distributions
(2.5mm x 2.0mm)

\[ \varepsilon_{yy} \text{ field, Load} = 52 \text{ grams} \]
\[ \varepsilon_{xx} \text{ field, Load} = 52 \text{ grams} \]

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Strain Distributions
(0.5mm x 0.45mm)

\(\varepsilon_{yy}\) field, Load = 47 grams

\(\varepsilon_{xx}\) field, Load = 47 grams

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Strain Distributions
(0.065mm x 0.055mm)

$\varepsilon_{yy}$ field, Load = 49 grams

$\varepsilon_{xx}$ field, Load = 49 grams

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Strain Distributions
(0.065mm x 0.055mm)

\[ \varepsilon_{yy} \text{ field (3-D), Load } = 49 \text{ grams} \]

\[ \varepsilon_{xx} \text{ field (3-D), Load } = 49 \text{ grams} \]

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Conclusions

- On the meso-scale, microstructure has a significant effect on the strain distributions.
- The basic crack growth mechanism consists of the coalescence of voids with the crack tip.
- The local deformation, damage mechanism, and crack growth mechanism in the two materials are similar.
- In the two materials, highly damaged regions, or failure process zones, are formed at the crack tip.