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MOTIVATION AND APPROACH

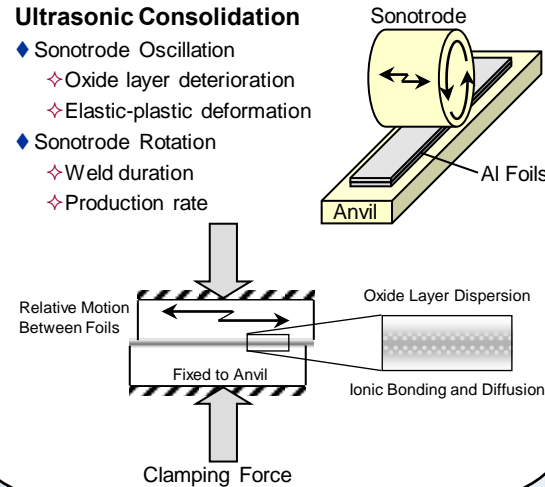
- ◆ **Benefit:** MMC's are Lightweight and offer increased Stiffness and Strength
- ◆ **Approach:** Develop a Tape Placement Process
 - ◇ Purchase and Produce MMC Prepreg Tape
 - ◇ Determine/Model processing parameters for consolidation of two tapes
 - ◇ Scale-up and automate the tape placement process



BACKGROUND

Ultrasonic Consolidation

- ◆ Sonotrode Oscillation
 - ◇ Oxide layer deterioration
 - ◇ Elastic-plastic deformation
- ◆ Sonotrode Rotation
 - ◇ Weld duration
 - ◇ Production rate



WELD COMPONENTS

There are many parameters that can be adjusted to produce the *perfect* weld. Balancing these parameters correctly is the key to good welds



- | | |
|--------------------|--------------------------|
| ◆ Stack | ◆ Controller |
| ◇ Horn (Sonotrode) | ◇ Speed |
| ◇ Boosters | ◇ Amplitude |
| ◆ Anvil | ◇ Pressure |
| ◆ Material | ◇ Ultrasonics Time Delay |

WELDS

When weld parameters are not properly chosen the material is either welded poorly, destroyed, or misaligned (see right). When chosen correctly, never before welded materials can be consolidated (bottom)!

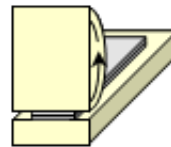


60% F_v MMC Tape



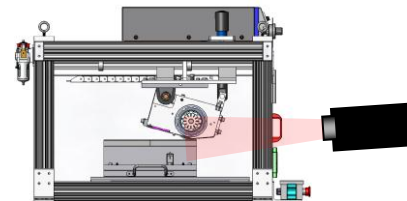
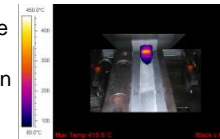
PROCESS MODEL

- ◆ Include Frictional Heating (surface flux) and Deformational Heating (volumetric heat generation) in Heat Equation
- ◆ 2D Thermal B.C.'s
 - ◇ Surface flux between foils
 - ◇ Volumetric heat throughout foils
 - ◇ Convection on all sides



THERMAL MEASUREMENTS

Using a front mounted IR camera it is possible to measure the temperature distribution on the surface of the foils at the nip point.



FUTURE WORK

- ◆ Determine "Good Weld" Criterion
- ◆ Couple Thermal and Mechanical Models
- ◆ Design Experiments to Validate Mechanical and Thermal Model

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