Optical Processing of Titanium

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Presented by: Michael K. Voisine
What we do

- Integrated product solutions
- Material Science & Processing Core
- Design support & problem solving
- Prototyping & development hardware
- Evaluation hardware & test support
- Limited & full rate production
Products and Offerings

- Advanced Armor Solutions
  - Active, Reactive, Passive
- Gunner Protection Kits
- Electronic Fire Control Hardware
- Mine Rollers
- Gun/Mortar Systems
- Integrated Structures
Our Titanium History

- Connecticut Industrial Base
- Energetics heritage
- Collaborative environment...Development of new techniques
- Effective cost solutions needed
- State of the Art Optical Processing Solution Development
- Winning solutions...program sponsorship...Ti winning trades!
Optical Processing

- What is it?
  - Coined in early 2000’s
  - Laser Energetics Heritage
  - Attractive Opportunity Space

- Cutting; Forming; Shaping; Heat Treating; Welding; Ablating…

- Enhanced applications of Titanium
  - Armor
  - Lightweight Hardware Solutions
Optical Processing

Key examples of its success:

- Armor Systems – Various Types
  - Efficient fabrication of over 500K components to exacting requirements
- Armor Shields – High Speed Cutting
  - Over 15X greater speed than conventional methods – up to \( \frac{3}{4} \)” thick
- Optically Formed Shapes...
  - Z Bar - Complex Bends – \( \frac{1}{2} \)” Plate
- Sensor Shields – Contoured Profile
Evaluating the Options

- Optically Processed Ti Plate
  - Allows trade matrix be expanded to consider additional factors
    - Total cost
    - Producibility
    - Upgradeability
    - Performance improvement
    - Scrap produced, etc.

<table>
<thead>
<tr>
<th>Option</th>
<th>Total Cost</th>
<th>Producibility</th>
<th>Upgradeability</th>
<th>Performance Improvement</th>
<th>Scrap Produced, etc.</th>
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</thead>
<tbody>
<tr>
<td>5083 H131 Machined Aluminum</td>
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<td>A206T71 Cast Aluminum</td>
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<tr>
<td>A206T71 Cast Aluminum with Titanium Reinforcement Wire</td>
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<td>Current BRASS Baseline</td>
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<td>5083 - H321</td>
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<tr>
<td>7075 - T651 (or T7351) Aluminum Machined Formed Ti</td>
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<tr>
<td>7075 - T651 (or T7351) Aluminum Formed Ti at 1/2&quot; providing spring effect</td>
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<tr>
<td>Original BRASS G Baseline build for Mockup XM33 collateral test baseline Howitzer parts for PICA/Army Standard part technology Current production BRASS High strength standard aluminum standard product adaptation</td>
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<td>Need for inserts</td>
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<td>Strength levels</td>
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<td>Weight all in (including inserts, coatings, etc. but no fasteners)</td>
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<td>Load management</td>
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<td>Key dimensions</td>
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<td>Corrosion resistance</td>
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<td>Burn resistance (assumes Alum burns easier than Ti or Steel)</td>
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<td>Cost</td>
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<td>Cost stability</td>
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<td>Long term supply availability/sustainability</td>
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<td>Producibility</td>
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<td>Ability to migrate to new variants with changing threats or requirements</td>
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<td>System weight impact (savings or gain over baseline BRASS)</td>
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(14 x 37.4 pounds is current or 518.6 pounds per system)
Combat Vehicle Example

- Steel...heavy...prone to rust
- Aluminum...light, low cost, available
- Aluminum with Steel...better, but issues
  - Machining Required...costly
- Machined Titanium...too expensive
- Optically processed Titanium plate
  - Lowest cost, highest performance
  - Selected solution!
Forward Defense Opportunities

- Reducing weight will be key...
  - Straight up steel/Ti trades need to be enhanced
  - Material cost in only one element
  - Processing technology plays a key role

- Optical shaping/enhancement can open new opportunity space

- Titanium Integration
  - Creating more value...doing it for less...and extracting more options
Summary

- Integrated Titanium Solutions offer a new frontier of value in Defense applications
- Optical processing is at the core of these enabling technologies
- Opportunities for enhanced performance exist
- Integrated Titanium is well positioned to enable meet the needs of tomorrow
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