Reversible Adhesive System To Improve Both Maintenance And Sustainment

Brian Kornish
PPG Industries, Inc.
Problem Statement

• Joining dissimilar materials creates new technical challenges for maintenance, including robust joining techniques, new modes of corrosion prevention, and repair solutions

• Conventional structural adhesives are thermoset and can only be cured once

• These adhesives cannot be reversed so that parts can be disassembled, repaired, or easily recycled, thus increasing maintenance and sustainment time/effort/costs
Technical Approach

• As an alternative, thermoplastic adhesives provide a means to reversibly adhere vehicle components

• The thermoplastic adhesive challenge is that the material must survive the temperatures of the manufacturing process and day to day use, and then be easily undone when desired

• Michigan State University has been conducting thermoplastic adhesive research using conductive nanoparticles to assemble and disassemble joints on demand
Technical Approach

• Thermoplastic adhesives reinforced with graphene nanoplatelets and ferromagnetic nanoparticles will be used to evaluate the **reversible bonding** behavior for a combination of steel, aluminum, and glass-fiber reinforced composite substrates.

Initial MSU development funded by Department of Energy Vehicle Technologies Office.
MSU Modeling/Simulation and Prototype
Overall Benefits

• Increase in fuel efficiency due to the lighter weight
• Faster and easier repairs of composite vehicles and perhaps aircraft
• Improvements in automotive repair for new materials and potential for composite part recycling
# Technology Deployment

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adhesive material selection and characterization, including PPG materials</td>
<td>Kickoff pending</td>
</tr>
<tr>
<td>2</td>
<td>Additive material evaluation FMNP and GnP</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Lab-scale joint evaluation</td>
<td>Later this year</td>
</tr>
<tr>
<td>4</td>
<td>Activation system development</td>
<td>Next year</td>
</tr>
<tr>
<td>5</td>
<td>Joint demonstration and commercialization evaluation</td>
<td></td>
</tr>
</tbody>
</table>
Project Team Participants

- US Army TARDEC – Product Life Cycle Engineering
- Michigan State University
- PPG Industries, Inc.