

**SBIR Topic Number:**  
AF04-133

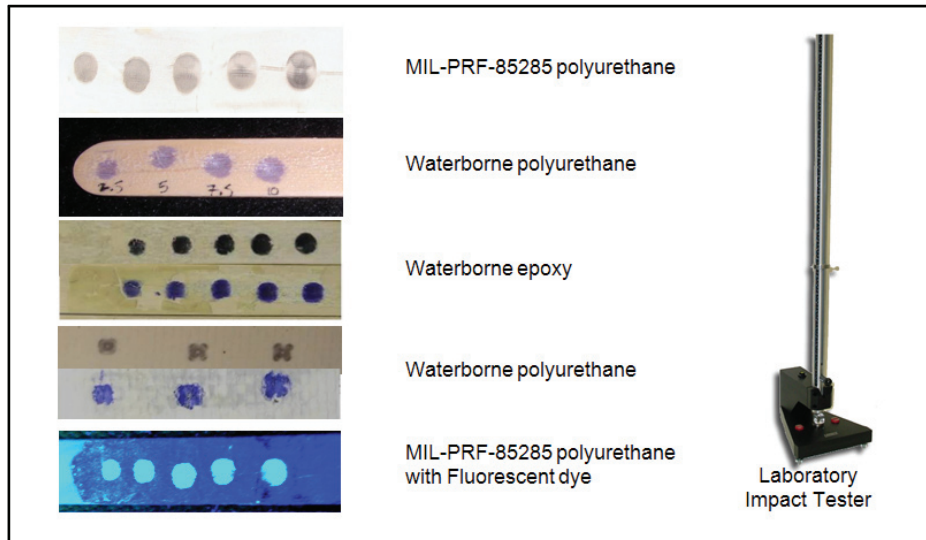
**SBIR Title:**  
Impact Indicator Paint for Composites

**Contract Number:**  
FA8650-05-C-5043

**SBIR Company Name:**  
Luna Innovations Inc.,  
Roanoke, VA

**Technical Project Office:**  
AFRL Materials and  
Manufacturing Directorate,  
Wright-Patterson AFB, OH

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



Selected Coating Systems with Impact Indicating Additives

## Impact Indicator Paint for Composites

- The Air Force has a requirement for an improved graphite fiber composite damage detection method for use at field and/or depot maintenance levels
- Luna Innovations has developed impact indicator paints for polymer matrix composites (PMCs) used as structural components in military aircraft
- Other potential applications include commercial aircraft, missile casings, marine craft, vehicle power trains, armor, and off-shore drilling platforms
- Luna has extended this technology, under a Navy-funded SBIR, to include damage detection from thermal events as well as impact events

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## Air Force Requirement

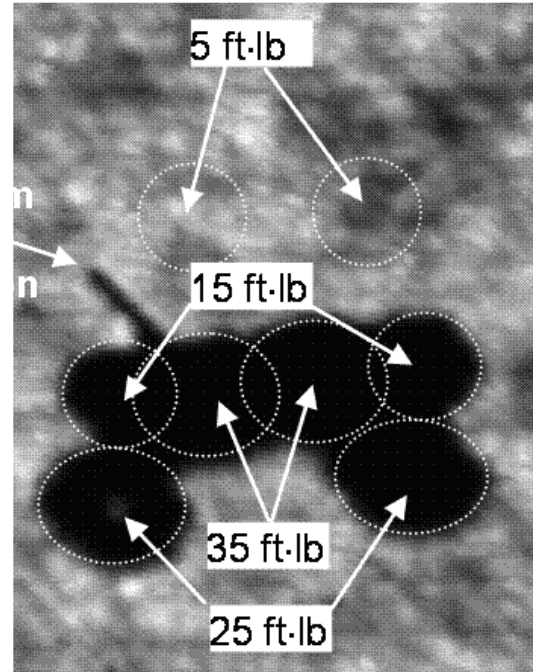
The Air Force has a requirement to develop a graphite fiber composite damage detection method which improves the rapidity, cost, and/or certainty of post-damage inspections at different levels of depth. This method should enable damage in such composites to be easily detected at field and/or depot maintenance levels. Possible technologies include pressure-sensitive paint that responds to impact by changing color due to microencapsulants, with different impact levels triggering different colors. Color change should readily indicate impact events to maintenance personnel, who can then focus on the detailed inspection and possible repair of affected areas. Such paint should be compatible with existing aircraft paint systems, and permit maintenance crews to work on the aircraft without triggering the impact detection properties of the paint.

## SBIR Technology

Under this SBIR program, Luna Innovations has developed the technology for impact indicator paints for polymer matrix composites (PMCs) used as structural components in military and commercial aircraft. This paint, when coated on a PMC component, will change color in response to an impact event not visible from the surface but capable of damaging the underlying substrate. This will allow aircraft field maintenance personnel to rapidly identify damage areas sufficient to cause low velocity impact damage (LVID) to the substrate without the use of expensive and time-consuming non-destructive testing equipment. This is illustrated by the photo showing an ultrasonic scan of an aerospace PMC panel impacted by an ASTM tester at the energy levels indicated, all of which were readily identified by Luna's impact indicator paint. The dark areas show that major deformation in the structure, indicative of delamination damage, occurs at or above 15 ft-lb impact energy levels. However, only the impacts at 35 ft-lb showed any minor visible damage to the top surface of the panel. Lower energy level impacts showed no such visible damage, illustrating the desirability of easily identifying impacts sufficient to cause damage to composite substrates that are not readily observable.

## Potential Air Force Application

This technology can be applied as damage sensing paint in any fiber reinforced structures used in a variety of



applications. Potential Air Force applications include all types of military aircraft which utilize PMCs as structural components. Potential Army and Navy applications include armor, advanced vehicle power trains, missile casings, and marine craft. Commercial applications include commercial aircraft, off-shore drilling platforms, and advanced sporting equipment.

## Company Impact

The impact indicator additive developed by Luna during this Phase II SBIR has been incorporated into existing aircraft coatings, as well as new low volatile organic compound (VOC) coatings developed in-house. Luna has also successfully demonstrated this technology with 7" composite missile casings under a US Army Aviation and Missile Command program at Redstone Arsenal, AL. Luna has subsequently extended this technology, under a Navy-funded SBIR, to include the ability to detect damage from thermal events as well as impact events. These successes will enable the company to remain on the cutting edge of the state-of-the-art in damage indicator paints for PMCs, thus improving their competitive position in this area.



# SBIR/STTR

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