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Advanced Initiation Systems Manufacturing Level 2 Milestone Completion Summary

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Advanced Initiation Systems Manufacturing

Level 2 Milestone Completion Summary

Project #: FY09.0210.1

Project Name: Advanced Initiation Systems Manufacturing (AISM)

Subprogram: ADaPT Lead Site: LLNL

Participating Sites: LANL, KCP

Milestone Description: Advanced Initiation Systems Detonator Design and Prototype

Milestone Grading Criteria: Design new generation chip slapper detonator and manufacture a prototype using advanced manufacturing processes, such as all-dry chip metallization and solvent-less flyer coatings. The advanced processes have been developed for manufacturing detonators with high material compatibility and reliability to support future LEPs, e.g. the B61, and new weapons systems. Perform velocimetry measurements to determine slapper velocity as a function of flight distance.

Results: The AISM team has satisfied and exceeded the Level 2 milestone.

1. Prototype Detonator

A prototype detonator assembly and stripline was designed for low-energy chip slappers. Pictures of the prototype detonator and stripline are shown in Figures 1 and 2.

All-dry manufacturing processes were used to address compatibility issues. KCP metallized the chips in a physical vapor deposition system through precision-aligned shadow masks. LLNL deposited a solvent-less polyimide flyer with a process called SLIP, which stands for solvent-less vapor deposition followed by in-situ polymerization.

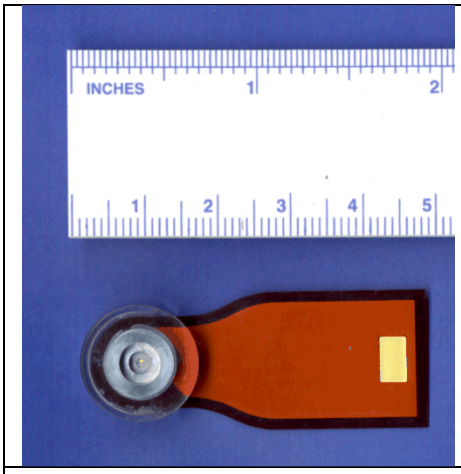

Figure 1a. Prototype detonator assembly. Plastic parts are transparent for viewing of internal components.

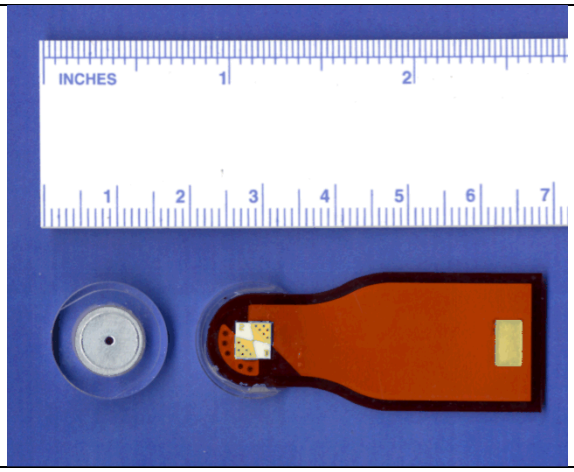

Figure 1b. Prototype detonator with top sub-assembly removed to show miniaturized chip slapper joined to stripline.

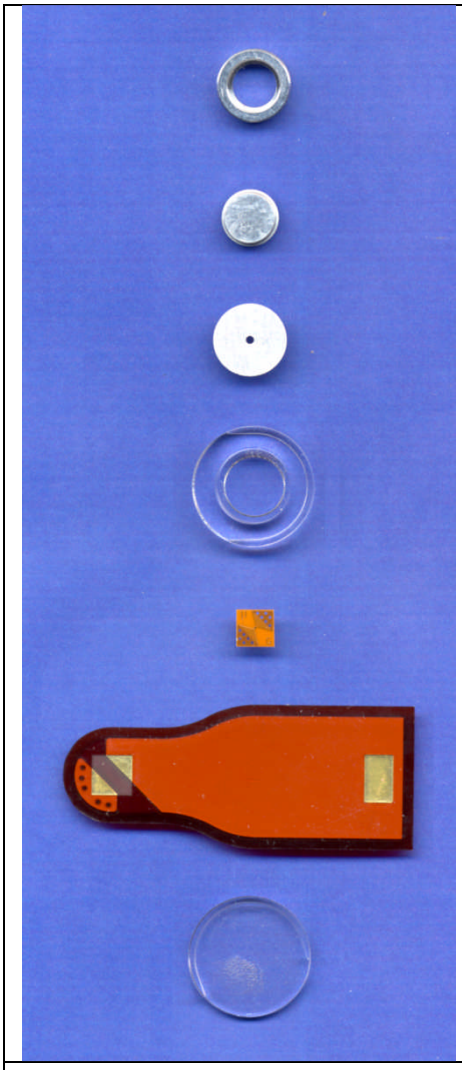

Figure 2. Low-energy prototype detonator components.

2. Test Fire of All-Dry Chip Slappers coated with Solvent-less Flyer Material.

LANL manufactured the high-surface-area (HSA) high explosive (HE) pellets. Test fires of two chip slapper designs, radius and bowtie (Figure 3), were performed at LLNL in the High Explosives Application Facility (HEAF). Test fires with HE were conducted to establish the threshold firing voltages. Pictures of the chip slappers before and after test fires are shown in Figure 4. Velocimetry tests were then performed to obtain slapper velocities at or above the threshold firing voltages. Figure 5 shows the slapper velocity as a function of distance and time at the threshold voltage, for both radius and bowtie bridge designs. Both designs were successful at initiating the HE at low energy levels.

3. Summary of Accomplishments:
   - All-dry process for chip manufacture developed
   - Solventless process for slapper materials developed
   - High-surface area explosive pellets developed
   - High performance chip slappers developed
   - Low-energy chip slapper detonator designed
   - Low-voltage threshold chip slapper detonator demonstrated

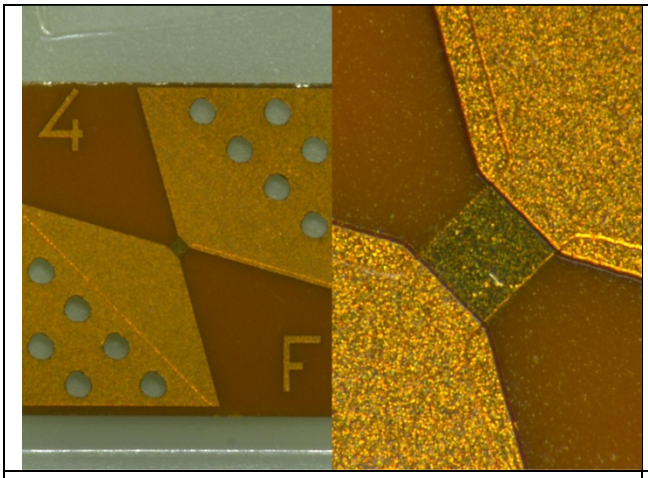

Figure 3a. Bowtie design of a SLIP-coated all-dry chip slapper.

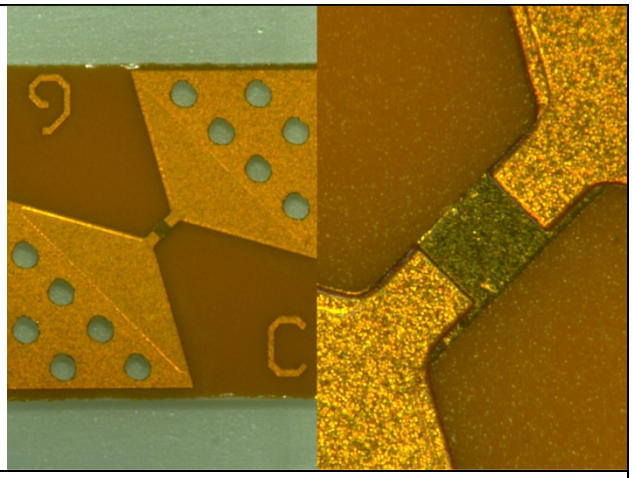

Figure 3b. Radius design of a SLIP-coated all-dry chip slapper.

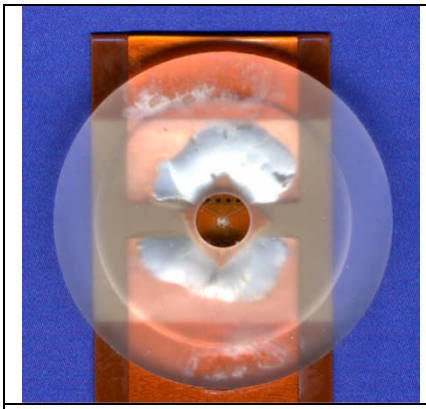

Figure 4a. Test fired SLIP-coated all-dry chip slapper.

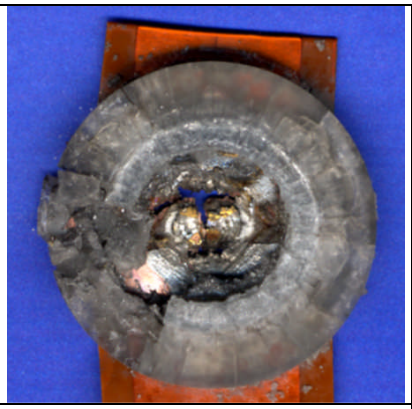

Figure 4b. Test fired SLIP-coated all-dry chip slapper with initiation of the high explosive.

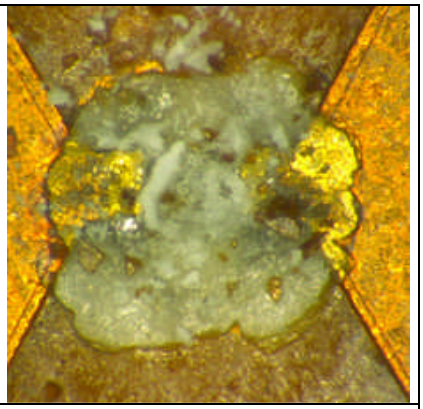

Figure 4c. Footprint of a SLIP-coated all-dry chip slapper after a test fire of the bridge without explosives. Note the flyer symmetry.

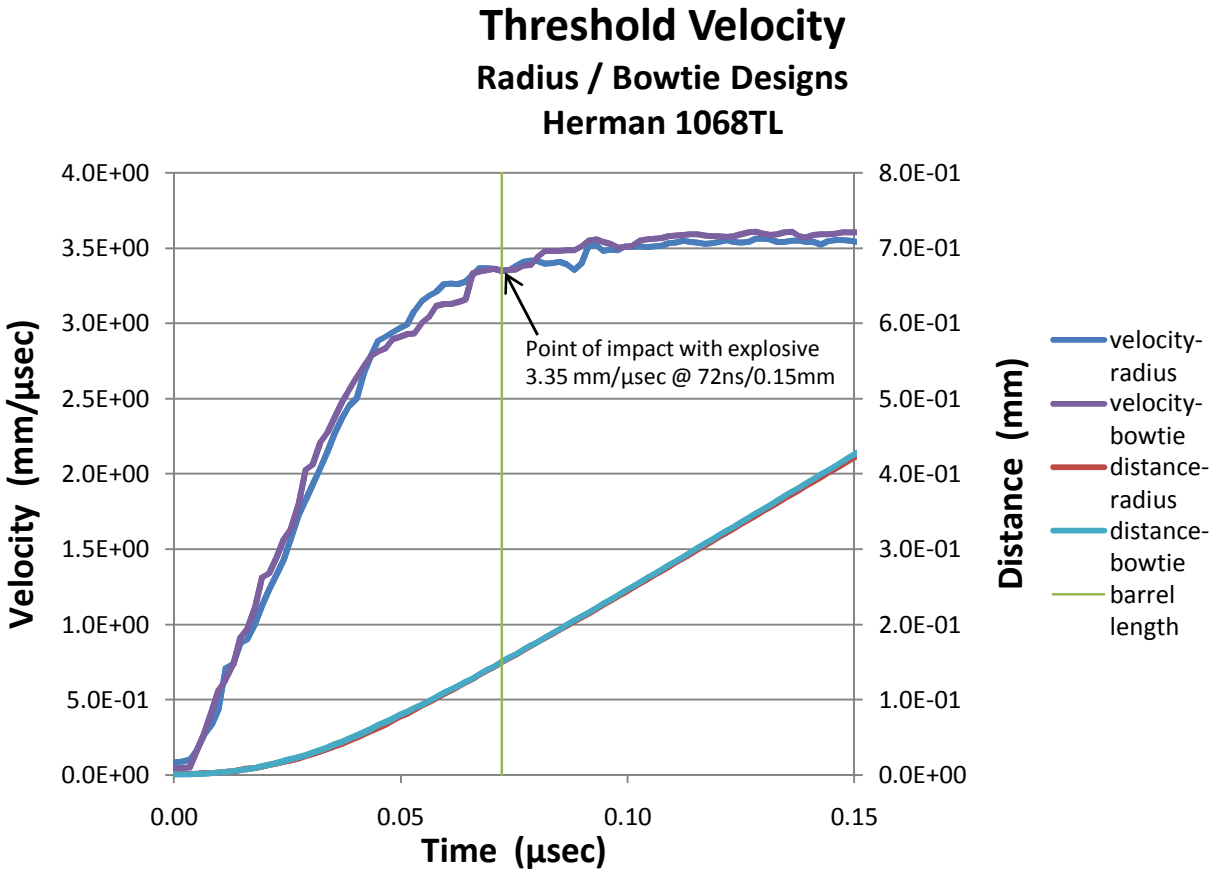

Figure 5. Velocimetry of SLIP-coated all-dry chip slappers. Two designs of chip slapper geometries were tested.

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Auspices:

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