

Reducing the End Item Cost of the MEMS Fuze Safe and Arm Device

S2379 - Improved Producibility of MEMS Fuze



OBJECTIVE

The purpose of this effort was to reduce the end item cost of the MEMS Fuze Safe and Arm Device that has been developed at Naval Surface Warfare Center, Indian Head Division (NSWC IHD) through funding from ONR Code 30, PM-AMMO, and PMS 495. The effort focused on developing processes to replace four inefficient manufacturing steps presently used to fabricate the MEMS Fuze. The goal is to transition the production of the fuze from a mix of batch and hand assembly processes to a nearly complete batch fabrication while eliminating inefficiencies in the design. Resulting from this work is a fuze for use in Flight Controlled Mortar in the PUMMA FNC. The reduced size of the MEMS Fuze will enable part the weapons guidance system of occupy volume preciously used by the fuze.

PAY OFF

Silicon MEMS technology offers multiple benefits that are directly applicable to fuzing and expanding the capability of Navy weapons. Conventional mechanical fuzes are complicated mechanisms that require significant investments of tooling, material, and manpower to produce. The sheer number of parts increases the likelihood of tolerance stacking and quality control issues that can lead to dud rounds or injuries to the warfighter. Instead of several vendors making tens or hundreds of individual parts, a MEMS Fuze would require a single vendor to make a single chip. They are inherently less susceptible to tolerance stacking or quality control issues due to precise micro scale batch fabrication and reduced part numbers. This feature improves reliability and consistency with reduced labor costs. By reducing the size of the fuze, volume that was previously taken up by bulky mechanical components can now be allocated towards sensors, advanced control mechanisms, or a larger warhead. The end result is a product that is cheaper, more reliable, and more flexible than a system based on conventional mechanical fuzing.

IMPLEMENTATION

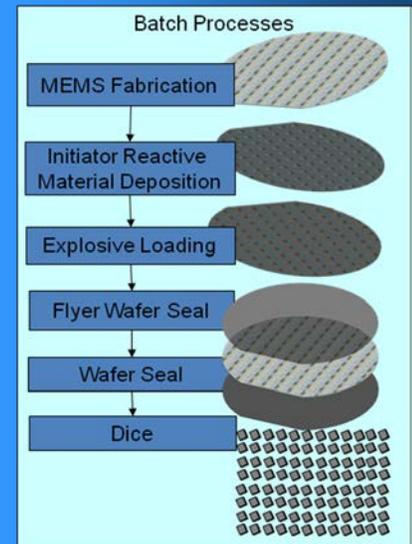
NSWC-IHD has previously demonstrated the successful batch fabrication of the silicon MEMS Safe and Arm (S&A) devices using 4 inch silicon wafers using the DRIE method. While previously these wafers were then diced into individual S&A sites, after which the explosive pellet and metal flyer for the micro-detonator was then hand assembled and each S&A site sealed with cap and bottom chips. This effort will replace above steps with a wafer level batch process which will result in completed S&A units after dicing. This allows all steps to be completed at the wafer level where nearly a hundred S&A devices can be processed simultaneously. To aid the explosive loading portion of this process, the output of the electric initiator used was increased thus removing the need for lead styphnate in the detonator. This will results in a simplified explosive train requiring only one energetic ingredient be loaded into MEMS structures. NSWC-IHD is implementing these processes in the production of its MEMS Fuzes.

Period of Performance
Jun. 2010 – Dec. 2011

Stakeholder
ONR Code 30

Performing Activity
EMTC

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Total ManTech Investment
\$1,000,000

Please visit the EMTC Web site:

<http://www.navsea.navy.mil/nswc/indianhead/codeCA/EMTC/main.aspx>

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