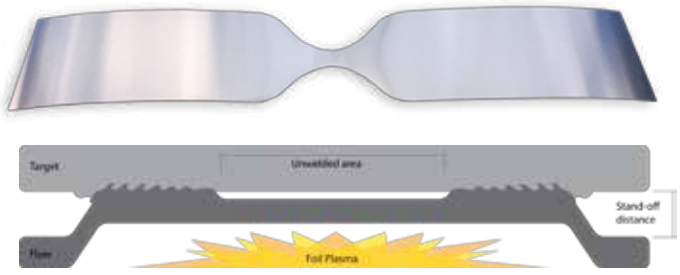
VAPORIZING FOIL ACTUATOR WELDING (VFAW)

Vaporizing foil actuator welding (VFAW) is a novel manufacturing process that generates strong metallic bonding between sheet metal structures. Most importantly, VFAW enables creation of welds between high-strength steel and aluminum alloy components, allowing for innovative multi-material structures to be produced. Implementation of this new bonding technology provides an effective means of reducing overall weight in vehicle assemblies, as it allows lighter aluminum alloy components to be utilized in place of heavier steel designs.

Welding between similar and dissimilar aluminum alloys is also possible using VFAW, producing joined regions with strength properties that exceed those of the parent material. Overall, VFAW provides a promising advancement for the future of vehicle manufacturing capabilities, enabling lightweight design implementation not possible by other means.

THE PROCESS

Through use of an ultrafast capacitor bank system, high intensity current is discharged through a thin aluminum foil structure (pictured below), causing a small portion of it to rapidly heat to the point of vaporization. The energized vapor generates a high pressure impulse behind a flyer workpiece, causing it to accelerate toward a target workpiece at speeds of several hundred meters per second. The impact event initiates jetting of surface impurities away from the impact zone and results in the formation of a strong interface between mating surfaces. Additionally, no heat-affected zone is generated with this technique, allowing for the original mechanical properties of the workpiece materials to be retained. This provides a new and useful means for creation of lightweight and multi-material vehicle structures, featuring high strength steel and aluminum alloys.



Vaporizing Foil Actuator Welding - In this technique, electrical energy stored in a capacitor bank is released through a switched circuit that contains a thin metal foil conductor (top picture). The schematic diagram illustrates the cross-section of the welding process.

PROPOSAL

The final configuration will be capable of conducting several sequential impact spot welds between large sheet metal structures, demonstrating versatility for use on future automotive joining applications.

VFAW Adapted for Fully Automated Robotic Welding

In order to advance the manufacturing readiness level of this technology, VFAW is being adapted for use with a fully automated robotic welding system. Similar high-volume production configurations are utilized for resistance spot welding processes, and this advancement of technology implementation will serve as an excellent demonstration of the potential capabilities for VFAW in a high-volume production manufacturing environment.

CHALLENGES FOR ADAPTATION TO ROBOTIC CONFIGURATION

In order to successfully adapt VFAW to this robotic configuration, a number of technical challenges must be addressed through proper design implementation

- Proper assembly fixturing to existing equipment
- Implementation of well-insulated, high-voltage terminal circuitry
- Durability of the housing assembly structure for repeated use
- Additionally, challenges concerning automated loading and unloading of foils used for each test will be addressed with this design, as well as solutions for maintaining clean, undamaged working surfaces for running successive trials.

HOW TO JOIN

This multi-industry project is intended to continuously evolve as new additive technologies, equipment, and processes enter the marketplace. The program will be executed and managed by CDME, which performs engineering and manufacturing services for industry partners. Interested industrial sponsors may join this program for a minimum price of $50,000, renewable each year based on the needs of the sponsor. Industry sponsors will have the ability to provide input into the work being performed that year, receive a monthly report detailing the program progress, participate in bi-monthly industry meetings, and receive the yearly edition of the technical report. The price for direct work will be negotiated on a case-by-case basis. Each year, the project team and current sponsors will set new targets for the work to be completed in the subsequent year.

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CDME is supporting the commercialization of technologies that emerge from Ohio State's annual research efforts. Ohio State has one of the largest research and development budgets of all universities. The amount of annual funding is a leading indicator of the breakthrough innovation occurring within the University. Recent annual highlights from OSU:

» $934 Million: Total research and development (R&D) expenditures
» $470 Million: Federal R&D expenditures
» $101 Million: Industry-sponsored research expenditures

Whether your interest is in licensing, sponsored research, joint ventures, investment, corporate giving, or placement of our best students; Ohio State is here to help accelerate your business through innovation.

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