

# 23rd MSU-IIT Annual In-House Review of Research and Development Projects



## Annual In-House Review 2025



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## CerMetaCS: Ceramic-Metal Composites for Structural Applications

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**Abstract:** Composite materials consist of a matrix and a filler, which, although immiscible, work synergistically to enhance strength and reduce weight, making them ideal for portable structural applications. Polymers are commonly used but often lack the required mechanical strength. To address this limitation, CerMetaCS, a ceramic–metal composite, was developed to enhance the performance of ceramic–polymer systems. Ceramic inserts from mining silt waste, with a high modulus of rupture, were used as fillers in an aluminum matrix for ballistic applications. Two fabrication routes were tested: investment casting and permanent mold. Investment casting failed to form complete layers, making the permanent mold a more suitable method for CerMetaCS fabrication. Characterization confirmed the suitability of local Nickel and Gold Mine Wastes (high Fe<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>) as reinforcement. Ballistic tests showed ceramic-reinforced composites outperformed monolithic aluminum, demonstrating both enhanced impact resistance and a sustainable approach to waste valorization.

**Key Words:** cermet; composite materials; ceramic-metal composite; mining wastes; sustainable materials; waste valorization

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