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# Mechanically Robust High Temperature Composites and Processes for Manufacturing Such Composites

**A cost-effective, net-shape fabrication method creates mechanically robust materials for high-temperature systems, providing superior resistance to erosion, creep, and fracture in applications like forming tools and engine components.**

Friction stir welding tools can be particularly attractive as a means for joining metals or metal alloys that soften at relatively low temperatures; however, metals or metal alloys that soften at high temperatures require a greater degree of heating during friction stir welding. Current materials used in friction stir welding tools exhibit too much erosion, plastic deformation, and/or fracture for use with metals or metal alloys that soften at high temperatures. There is a need for friction stir welding tools that are capable of operating at high temperatures and made from materials that are more cost effective.

Researchers at Purdue University have developed a net-shape and net-size method for fabricating mechanically robust materials for use in high-temperature systems. Uses include fabricating the desired shapes for friction stir welding tools, hot forming tools and engine components. The materials provide greater resistance to erosion, creep, plastic deformation, and fracture at high temperatures and fabricated in a more cost-effective manner when compared to currently used materials.

**Advantages**:

-Works in high-temperature systems

-Cost effective

Potential Applications:

-High temperature systems, e.g., transportation, propulsion, power production, and manufacturing

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**Category**
Materials Science & Nanotechnology/Materials Testing & Characterization Tools
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-High temperature forming tools, e.g. friction stir welding tools, dies for hot extrusion, hot pressing, hot drawing, and hot rolling

-Engine components, e.g., turbine blades, compressors, shrouds, combustion chambers, and valves

**TRL:** 4

**Intellectual Property:**

Provisional-Patent, 2016-10-05, United States | PCT-Patent, 2017-10-05, WO | NATL-Patent, 2019-04-02, United States

**Keywords:** high-temperature systems, friction stir welding tools, mechanically robust materials, hot forming tools, engine components, cost effective materials, erosion resistance, creep resistance, plastic deformation resistance, fracture resistance