

Developing polymer-based metal matrix composites

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ABSTRACT

Materials with high strength and stiffness are in massive demand for numerous industrial applications that thrive to achieve enhanced fuel performance, increased payload, and lightweight. This has resulted in developing a new class of materials known as metal matrix composites (MMCs). The strength and ductility of MMCs primarily depend on the particle size distribution, bonding between matrix interfaces, and agglomeration of particles. A new and patented technique known as Polymer Derived Ceramic (PDC) MMCs can overcome several shortcomings of conventional processes and manufacture high strength, high ductility MMCs. It uses a polymer that converts itself into ceramic when heated is first mixed with the matrix. Here we aim to use Friction Stir Processing (FSP) technique to mix and spread the nano-sized Polymethylhydrosiloxane (PMHS) polymer particles into Al metal matrix. Due to the solid-state nature of the FSP process, the fracture of the polymer particles is easier, and all the agglomeration can be avoided. In this summary of work to date talk, I shall touch upon various methods of reinforcement dispersion and initial results. To achieve minimum agglomeration and repeatability in results, the reinforced particles should be of nanoscale. Therefore, I shall also talk about the design and development of customized cryo ball mill machine. The design procedure is based on some important calculations and customized need for better output.

ABOUT THE SPEAKER

Dr. Sachin Kumar is an Institute of Eminence post-doctoral research associate in the Surface Interaction and Manufacturing (SIAM) Laboratory, with Prof Satish V Kailas. He currently works on developing polymer-based metal matrix composites of Al alloys using friction stir processing route. Previously, he was a doctoral student at Shandong University China (ARWU Shanghai 2020 world ranking 151-200), working with Prof. Wu ChuanSong. His doctoral thesis was on intermetallic diminution by ultrasonic vibration assistance in friction stir welding of dissimilar Al and Mg alloys. Dr. Sachin Kumar has also been associated with IIT Kharagpur and NIT Hamirpur.

