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FOREWORD

Special Issue on Additive Manufacturing

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In the recent past, manufacturing of the industrial products has undergone revolutionary changes due to the emergence of additive manufacturing (AM). AM is generally considered as the process of building parts by joining materials layer by layer through computer-aided-design (CAD) software or 3D object scanners. The CAD software directs hardware to deposit material layer by layer and creates the objects in the desired geometric shapes. AM offers the flexibility in designing various components, where the implementation of design concepts were considered impossible in the past. The process has immense technical potential in manufacturing custom built parts, as alternate to integration of multiple small parts to produce a component and to repair parts.

The field of additive manufacturing has been flourishing for more than a decade now due to the need for optimal processes for all the projected sectors, namely aerospace, transportation and biomedical devices. An outstanding success has been achieved in manufacturing some critical parts used in jet engines and race cars. The demand for production of parts used in health care industry is souring up since the safety and efficacy of AM-built medical devices is proven. It is one of the fastest growing area cutting across the boundaries of metallurgical, mechanical, aerospace, mechatronics, non-destructive evaluation, computer science and manufacturing engineering disciplines. Almost every sector is now adopting some form of additive manufacturing in their production chain.

There are several unexplored areas where concentrated research efforts are currently underway in academic, research and industrial units world-wide. Many of the AM parts exhibit unfavourable properties in their as-built state that includes complicated microstructures that are characteristic of either casting, powder sintering and or multi-pass welding processes, reduced static strength and elongation at failure, reduction in fatigue life, high surface roughness, porosity, inclusions, and residual stresses. Furthermore, AM parts exhibit a strong texture-based anisotropy that may have significant effect on mechanical properties. Assessment of the mechanical properties, deformation and fracture behaviour of AM parts containing residual stresses, geometrical defects and anisotropic microstructure is a difficult task. However, due to the excellent technological promises, there has been upward trend in knowledge exploration in this "rapidly evolving" field with innovative processing, heat treatment practices and adopting several advanced characterization techniques for the evaluation of microstructure.

While a large number of scientific papers are getting published on additive manufacturing, a closer look at some of the latest publications clearly reveals an ever-growing interest in unravelling the science, engineering and technology behind additive manufacturing. The mechanism involved in the process is a complex hybrid of the mechanisms of sintering, solidification and welding, hence extremely difficult to understand.

In view of the importance of Additive Manufacturing, a special issue of TRANSACTIONS OF INDIAN NATIONAL ACADEMY OF ENGINEERING, has been organised emphasizing different aspects of additive manufacturing where the engineers, scientists and technologists from India and abroad have shared their comprehensive understanding of the state-of-the art pertaining to their specialisation. This issue contains both invited and contributed papers pertaining to topical reviews in various aspects of additive manufacturing and current research results on this topic.

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