Chapter 2
3D-Printed Polymer Composite: A Bibliometric Approach – What, Where, and Who Is Doing Research on This Topic

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ABSTRACT

Due to the recent innovations in 3D-printed polymers research, this study presents a systematic overview of the area, exposing gaps and interesting directions for future research. The current study investigated the trend of research growth using 2558 research papers with 97131 references data collected from the Web of Science Core Collection database (WOS), over the period from 2005 to May 2022, using bibliographic coupling and keyword co-occurrence. The research results allow the authors to conclude that the number of publications in this field's importance has grown tremendously over the last 20 years, with the United States, China, United Kingdom, and India emerging as the countries that publish the most. The top five researchers in 3D printed polymer composite were also identified.

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INTRODUCTION

Additive manufacturing, widely termed as three-dimensional printing, has progressed and completely altered fast in recent decades. Various technological aspects of 3D printing are now frequently employed in many areas (Ngo, 2018).

Production cost and time is a crucial differentiator between 3D printing and traditional manufacturing. This dynamic is altered by 3D printing. It removes the need for tooling and allows manufacturing to begin immediately after design. This implies a shorter time to market, which gives a competitive advantage (Steenhuis, 2016), (León-Calero, 2021). Each new unit generated by 3D printing incurs no further expenditures. This implies it can create a single part as well as hundreds of pieces at almost the same cost per part (Attaran, 2017). On the other hand, 3D printing operates on the premise of additive manufacturing. The product is designed from the ground up to reduce waste (Gomes, 2022). Topology optimization, and generative design may all be used to minimize material utilization and product weight.

One of the additive industrial technologies is extrusion-based 3D printing that encompasses depositing melted thermoplastic material layer by layer sideways a specified processing pathway after extruding it from a heated nozzle. Since the 1990s, this method has been the furthermost current 3D printing procedure for thermoplastic supplies (Parandoush, 2017), (Shahrubudin, 2019).

The thermosets, thermoplastics, polymers, blends and biological systems are among the polymers employed. Polymer design, processing parameters and additives are discussed in relation to increasing build speed and improving surface polish, accuracy, functionality and mechanical qualities (Ligon, 2017).

Previous research on material extrusion 3D printing has resulted in substantial advancements in material, equipment, and production method (Blok, 2018). Various studies strive to emphasize the variety of 3D printed metal-metal, ceramic-metal and polymer-based applications while exploring the benefits and limitations of additively made multi-material structures (Bandyopadhyay, 2018) The number of studies on 3d printing of multi-material components has increased remarkably. Some multi-material additive manufacturing surveys are already available in the literature. In response to the increased attention in this field, the current article attempts to give a more thorough and up to date assessment of 3D printing of multi-material components by assembling a full collection of additive manufacturing using multiple materials technologies that have been published in peer-reviewed journals (Rafiee, 2020). The functional features of the 3D-printed complex structures are intriguing, and showed how a 3D-printed elastomer like this may be used and opened the door to the future creation of revolutionary soft robotics (Kuang, 2018).

Many researchers have created novel compositions and substances for use in 3D printing processes, the majority of polymer-based biocompatible are 3D printed, the objective is to create functioning and viable organs, and in order to do so, numerous biomaterials and production processes must be investigated (Jammalamadaka, 2018). Some research, on the other hand, focus on the temperature history of printed in 3D polyphenylene sulfide (PPS) parts and assess the thermal processing parameters' impacts and circumstances of heat treatment on mechanical properties. According to the findings, forced air cooling in fused deposition modeling can improve the precision of 3D printing (PPS) samples (Geng, 2018).

Related to the mechanics of helicoidal composites, the adaptive conduct in helicoidal designs is demonstrated through completing a mechanistic investigation of the variations happening in the cuticle of the mutabilis over its life cycle, was exanimated with 3D printing sample testing and a comprehensive examination of the role of pitch angle in the intrinsic mechanics of helicoidal designs (Zaheri, 2019).

Thermoplastics may be processed using extrusion-based additive manufacturing methods because they become soft and processable above their melting point on a regular basis (Shafranek, 2019). Because