Design and Manufacturing of Composite Materials using 3D Printer

Ryosuke Matsuzaki[1,*], Taishi Nakamura[1], Yusuke Yamagata[1], Akira Todoroki[2], Masahito Ueda[3] and Yoshiyasu Hirano[4]

[1]Tokyo University of Science, 2641 Yamazaki, Noda, Chiba 278-8510, Japan.
[2]Tokyo Institute of Technology, 2-12-1 O-okayama, Meguro, Tokyo 152-8551, Japan.
[3]Nihon University, 1-8-14 Kanda-surugadai, Chiyoda, Tokyo 101-8308, Japan.
[4]Japan Aerospace Exploration Agency, 6-13-1 Osawa, Mitaka, Tokyo 181-0015, Japan.
[*]Correspondence Author: Ryosuke Matsuzaki Email: rmatsuza@rs.tus.ac.jp.

Abstract: When continuous carbon fiber composites are molded with a 3D printer, three-dimensional complex structure can be integrally molded, which leads to reduction of manufacturing time and cost. In addition, because the curved continuous fibers can be printed in a plane when the 3D printer is utilized, the design space and capability of 3D printed composites will drastically expand compared with using just straight fibers such as conventional prepreg. However, printing accuracy of composite materials may be affected uniquely by parameters such as number of fibers in tow, printing curvature, compaction pressure etc. In this study, we investigated to construct an appropriate design and manufacturing scheme for continuous fiber composite 3D printer. First, we developed a 3D printer capable of molding continuous carbon fiber composites based on fused deposition modeling. In this 3D printer, the thermoplastic resin filament containing continuous carbon fibers is melted inside the nozzle of the printer head and deposited on the flat table. We successfully demonstrated several complex structures that had curvature radius of lower than ten millimeters. We evaluated the printing accuracy by varying parameters such as the curvature of printing path trajectory. Finally, we also investigated the effects of using twisting fibers on the printing accuracy.

DOI:10.32604/icces.2019.05205 www.techscience.com/icces