

효율적인 약물 전달을 위한 Schwarz 의 Gyroid 표면 구조가 적용된 마이크로로봇 개발

Magnetic Microrobots with Schwarz's Gyroid-surface Structure for Efficient Drug Delivery

*정세영(전남대학교), 고광준(전남대학교), 임승현(전남대학교), 남명혜(전남대학교),
김석재(한국마이크로로봇연구원), 이택수(한국마이크로로봇연구원), 박종오(전남대학교),
방도연(전남대학교), *최은표(전남대학교)

*S. Zheng, G. Go, S. Im, M. Nan, S. Kim, T. Lee, J.-O. Park, D. Bang, *E. Choi

Key words : Precise delivery, Microrobot, Two-photon Polymerization

Precise delivery of drugs through microrobots has received widespread attention as a promising therapeutic technique due to its ability to remote controllability and reducing pain and risk of infection. However, the 3D structure of the microrobots often suffers from unsatisfactory in high locomotive efficiency and effective drug payload capacity. Therefore, we report on the modeling and synthesizing of the microrobots with a triply periodic minimal surface (TPMS) type structure: G (gyroid)-surface cube via a Two-Photon Polymerization (TPP) method using a 3D laser lithography system to overcome the previous drawbacks. The surface area of this structure is optimized by changing the surface curvature distance to increase the drug payload capacity. In addition, the surface of the microrobots was modified with magnetic nanoparticles to endow high locomotive capacity under electromagnetic actuation (EMA) control system. Moreover, we manufactured different surface curvatures of the G-surface cube to maximize the physical properties of the microrobots structure. Compared with the normal cube, the proposed gyroid-surface of the microrobots with 3D structures demonstrates a considerably improved drug loading capacity, which can be ideal candidates for various applications in medical fields.

후기 This work was supported by the Korea Medical Device Development Fund grant funded by the Korea government (the Ministry of Science and ICT, the Ministry of Trade, Industry and Energy, the Ministry of Health & Welfare, the Ministry of Food and Drug Safety) (Project No. 202012D19) This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (Grant No. HI19C0642).

*발표자, *교신저자(echoi@kimiro.re.kr)

초단펄스 레이저를 이용한 유연 배터리의 비손상 프리폼 커팅 기술

Damage-free Freeform Cutting of Flexible Battery using Ultra-Short Pulse Laser

*지석영(과학기술연합대학원대학교), *장원석(한국기계연구원)

*S. Y. Ji, *W. S. Chang

Key words : Femtosecond laser, Freeform cutting, Flexible battery, Hybrid foil

Along with the progress of flexible devices, many researchers are highly interested in manufacturing of flexible battery with freeform in various scale. Laser cutting is considered one of essential process to achieve on-demand manufacturing but continues wave or long-pulse laser beam may cause large heat affect zone (HAZ) in cutting edge and even failure of battery function. In this study, it is demonstrated that the sophisticated cutting process using ultra-short pulse laser is applicable for tailoring of flexible battery with multilayered structure. Based on the comparison of cutting results using nanosecond laser and femtosecond laser, we confirmed that laser cutting by femtosecond laser induce much less thermal damage on thin foil electrodes, separator and electrolyte. Furthermore, we investigated the interaction of femtosecond laser with the materials composed of flexible battery, and implemented a process for cutting each material without critical damage. In order to prevent a short circuit between anode and cathode, which usually occurs during laser cutting of the actual battery, we performed the double-side cutting process with adjusting focal points of laser beam. We expect that the proposed approach can be applied in roll-to-roll based cutting process for mass-production of flexible device.

*발표자, *교신저자(paul@kimm.re.kr)