Hybrid Additive and Subtractive Patterning of Bovine Serum Albumin Microstructures by Femtosecond Laser Direct Write

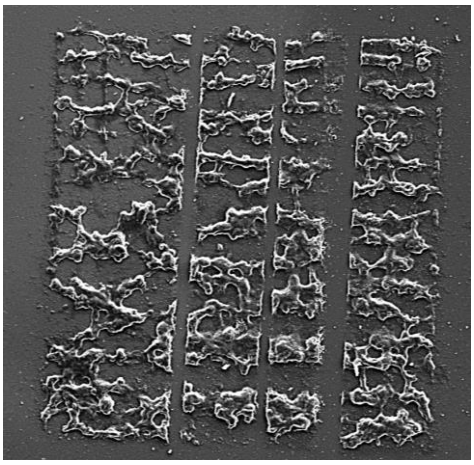
◦**Daniela Serien[1], Koji Sugioka[1]**

RIKEN Center for Advanced Photonics[1]

E-mail: daniela.serien@riken.jp

In this work, we demonstrate subtractive femtosecond laser direct write (fs-LDW) ablation of microstructures made of protein bovine serum albumin (BSA) by additive fs-laser multiphoton cross-linking to diversify the patterned structures. Laser ablation of biomaterials is useful to modify the surface or structure the material to suit applications such as tissue engineering [1] and bioimplants [2].

In our recent work, we have fabricated 3D microstructures from pure protein precursor by additive fs-LDW [3]. For the two-photon absorption, it is expected that the affected precursor material in volume becomes smaller than the focal volume [4]. However, there is a trade-off between high protein concentration for successful fabrication and ideal precursor properties for smallest feature sizes because the refractive index increase with high protein concentration deteriorates the fabrication resolution. We believe that subtractive laser ablation is a useful approach to further define proteinaceous microstructures after additive fabrication. Such hybrid approach could modify the proteinaceous microstructures interactively by non-invasive light processes, specifically, in-situ modification of scaffold for spatiotemporal control of cell culture.



Dried Bovine serum albumin microstructure was cut by 525 nm femtosecond laser in air. Vertical cutting lines show clear cutting edge.

[1] V. A. Kumar, A. W. Martinez, J. M. Caves, N. Naik, C. A. Haller, and E. L. Chaikof, Biomed Mater. 9, 011002 (2014)
[2] A. Kurella, and N. B. Dahotre, Journal of Biomaterials Applications 20, 5 (2005)
[3] D. Serien, and Koji Sugioka, ACS Biomaterials Science & Engineering, http://dx.doi.org/10.1021/acsbiomaterials.9b01619
[4] K. Sugioka, and Y. Cheng, *review* Appl. Phys. Rev. 1, 041303 (2014)