Topological design of 3D composite scaffolds and their mechanical features

Oleg Dubinin, Stepan Konev, Igor Shishkovsky*
Skolkovo Institute of Science and Technology, 30 Bolshoiy boulevard, bld. 1, 121205 Moscow, Russia: E-mail: I.Shishkovsky@skoltech.ru

Keywords. topological design, scaffolds, poly(vinyl alcohol) and polylactide composite**,** mechanical testing

Abstract.

At present study, we developed topological design of proper models of bone structure. Two types of scaffold were generated. The 3D structures of hepatic tissue and muscle tissue scaffolds were carried out to include vessels, main cell line and connective tissue. Parameters of scaffolds included requirement of printers, for that both structures could be modified to get both viable tissue structure and printing ability.
The material HARZ Labs Model LCD/DLP Cherry was used for 3D bioprinting. The structure was printed and post-cured in isopropanol. Post-treatment was conducted in water bath for PVA removing. Unfortunately, not all the resin was removed during post curing. Pore size was defined. The filling percentage of supporting elements was 60%. So, it was recommended that the model should be changed for future printing. Some improvements were done with supporting elements.
Result of stress-strain test was unique, because of the our composite (PVA+PLA) were more similar to a real tissue structure. Pores between PLA were fulfil with PVA, which has adhesive properties. But this structure also had “critical point”, that means it has a different internal strength structure and after fracture of supporting structures further compression proceeds according to other parameters. The PVA had higher plasticity and viscosity in comparison with photopolymer and broke smoothly. The structure of the side beams also shown that due to the elasticity, the pore volume was redistributed and, with an incomplete load, the structures that are located in them were remained alive.