Two-photon polymerization of polymeric and hydrogel scaffolds for 3D neural cell culture

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Abstract:

Cells in our bodies are arranged in three dimensions (3D) according to complex architectures, which play a fundamental role in the functionality of the living tissue. There is therefore an urgent need to develop 3D architectures featuring the physico-chemical properties necessary for the proliferation, differentiation and functionality of living cells. To date, the methodologies employed to manufacture 3D architectures for cell culture and tissue engineering applications include, among the others, fused deposition modeling, ink-jet printing and electrospinning that, although relying on a wide materials' library, lack either the possibility to create true 3D free-standing architectures without the presence of sacrificial supports or cannot reach micrometric feature resolution.
In this talk, I will give an overview of my most recent research activity related to two-photon direct laser writing (2P-DLW) of 3D freestanding microenvironments where the physical mechanism behind the fabrication exploits the two-photon absorption (TPA) of near-infrared (NIR) radiation by focusing femtosecond laser pulses onto an organic photosensitive pre-polymer material. I will in particular show the realization of polymeric and hydrogel scaffolds allowing the formation of ramified 3D neuronal networks, as well as the advanced 3D imaging protocols, combining SEM, two-photon imaging and light-sheet microscopy, able to unveil functional features of neural cells within the most inaccessible core regions of the scaffolds.