Bioresorbable phosphate glass microstructured optical fiber for simultaneous light and drug delivery

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Biomedical needs have recently boosted the development of brand-new multifunctional and bioresorbable optical fibers, especially in the field of theranostics. Biocompatible fibers represent great tools for in-body monitoring, diagnostics, and photo-dynamic therapy, thanks to their ability to carry light and act as a drug delivery system in capillary form. Optical fibers are also convenient because of their production scalability since they can be drawn into kilometers starting from a single preform, thus limiting production costs. Furthermore, biocompatible optical fibers can be easily adapted to different applications since they can be well integrated into catheters and other medical instrumentations. In this scenario, calcium-phosphate glass (CPG) optical fibers are promising candidates, thanks to their enhanced thermo-mechanical features and biocompatibility. Moreover, their resorbability, as well as mechanical and optical properties, can be finely tuned by tailoring the specific glass composition. In the present work, we report on our latest results in this field starting from the full characterization of CPG optical fibers by means of in-vitro dissolution tests and in-vivo experiments. Dissolution tests in simulated body fluid revealed that a high amount of MgO can effectively decrease the dissolution time, while in-vivo experiments showed no inflammatory response in the tested animals. The possibility of tailoring the resorption time of the CPG fiber is a key factor in several applications where different operational times are needed, e.g. from few days to few months. In addition, we will show the application of a CPG-based multifunctional fiber to deliver a photosensitive drug and its activation by light carried with the same fiber. Finally, we will report on the design and fabrication of a bioresorbable microstructured CPG fiber by properly combining rotational casting and extrusion techniques.