UNIVERSITY OF BRESCIA

PhD Program
in
TECHNOLOGY FOR HEALTH

REALIZATION AND OPTIMIZATION OF INNOVATIVE STIMULI-RESPONSIVE MATERIALS FOR BIOMEDICAL APPLICATIONS

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Background

Among stimuli-responsive materials, shape memory polymers (SMPs) have received particular attention in the last years thanks to their capability to undergo significant shape changes in response to an external stimulus. This behaviour is considered promising in the field of health science; for example they may be employed for the realization of smart biomedical devices for minimally invasive surgery, such as vascular and/or esophageal stents; for the development of *in situ* self-deployable and active scaffolds for tissue engineering; for the design of innovative platforms for drug release applications according to proper triggers. Furthermore, the applications of SMPs can be improved thanks to the possibility to employ 3D printing as a potential processing technique, overcoming issues related with the realization of devices with complex geometry and/or capable of complex shape variations. The combination between 3D printing and SMPs, often referred as "4D printing", is a growing and stimulating research topic, in particular for what concerns the biomedical applications, for which the chance to customized devices thanks to the 3D printing process is a key point in order to fulfil the current needs in Medicine.

Objectives

The main objective of the research concerns the realization of SMP-based products through non-conventional processing techniques (electrospinning; 3D printing), and to optimize their functional behaviour with the final aim of developing an innovative pre-prototype in one of the three areas of my research interest, i.e. biomedical devices, tissue engineering, drug delivery systems.

Methodologies

The methodologies to be employed are mainly related to the typical material engineering approach and are schematically listed in Fig. 1, following the whole prototype development since the material selection, through the early thermo-mechanical testing and through the evaluation of its potential behaviour as biomedical device.

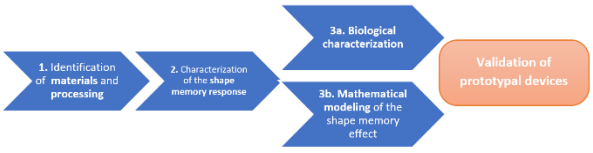

FIGURE 1. METHODOLOGIES TO BE EMPLOYED: SUBDIVISION INTO DIFFERENT SUBSEQUENT ACTIVITIES

Expected Results and Impact

The main results of this research should lead to a detailed understanding of the applications of novel SMPs-based products to the biomedical field and to found the basis for the development of innovative functional stimuli-responsive devices.