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Identification of absorbable polymers for additive manufacturing of personalized stents

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Abstract

The standard treatment of coronary artery disease is the implantation of metallic stents. In the field of metallic implants, a large number of developments have taken place in recent years, focusing in particular on the optimization of stent geometry, surface design and coating with various active substances, but also on manufacturing processes. To avoid adverse side effects of metal stent therapy, such as degradation of blood components or restenosis, absorbable polymer stents have been developed, which dissolve after successful treatment of the stenosis. This absorption process can be combined with the time-delayed release of drugs. Moreover, personalized polymer stents of specific size and shape can be rapidly fabricated by additive manufacturing methods. In this work, bioabsorbable stents are produced from biopolymers such as PLA and PCL using an additive manufacturing process. First, absorbable polymers are evaluated for their thermal behaviour and suitability for additive manufacturing of stents. This is followed by an assessment of the mechanical properties of the polymer. Using a selected PLA, stent structures with a layer thickness of 250 µm are produced in a pellet printer using the Arburg Plastic Freeforming (AKF) method. The structure and surface of the printed stents is determined by scanning electron microscopy and atomic force microscopy at high resolution and investigated for their wettability. The identified absorbable polymers will then be printed in a custom 3D printer with a specialized nozzle to form stents with layer thicknesses of less than 200 µm.

Figure 1: Mirror mechanism with a spider