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PROCEEDINGS

Microstructures and Nanomechanical Properties of Additively Manufactured Metallic Stents

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ABSTRACT

Additive manufacturing emerges as an innovative technology to fabricate medical stents used to treat blocked arteries. However, there is a lack of study of underlying microstructure and mechanical properties of additively manufactured stent. In this work, additively manufactured 316L stainless steel stent was investigated, with electrochemical polishing being used to improve the surface finish. Microstructural characterisation was carried out using optical microscopy, scanning electron microscopy, and electron backscatter diffraction. The hardness and elastic modulus were measured using Berkovich nanoindentation, with an emphasis on the effect of grain orientation. In addition, spherical nanoindentation was used to obtain indentation stress-strain curves based on load-displacement responses. The results showed that electrochemical polishing was effective in reducing the average surface roughness, although not reaching the level of commercial stent. The additively manufactured stent demonstrated a hierarchical grain microstructure with columnar grains and cellular sub-grains, as opposed to equiaxed fine grains and twins in commercial stent. The hardness and modulus of additively manufactured stent were higher than those of the commercial one. The grains close to the (111) orientation exhibited the highest hardness and elastic modulus followed by (101) and (001) orientations. The indentation stress-strain curves, yield strength, and hardening behaviour of additively manufactured stent were similar to those of commercial stent. This work provides a helpful understanding of the microstructure and properties of additively manufactured stent and outlines the technical barriers in the development of additive technology for innovative manufacturing of stent.

KEYWORDS

Metallic stents; additive manufacturing; material microstructure; mechanical properties; nanoindentation

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