ZERNIKE INSTITUTE COLLOQUIUM

Thursday, June 7th, 2018

16:00h, Lecture Hall: 5111.0080 Coffee and cakes from 15:30h

Multiplicity of morphologies in poly(L-lactide) bioresorbable vascular scaffolds

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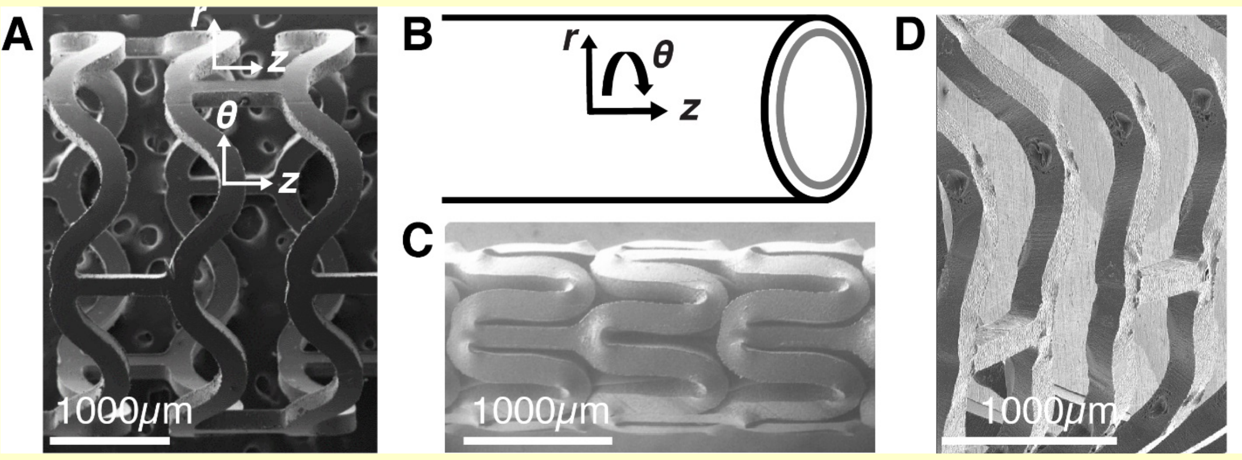
Poly(L-lactide) (PLLA) is the structural material of the first clinically-approved bioresorbable vascular scaffold (BVS), a promising alternative to permanent metal stents for treatment of coronary heart disease. BVSs are transient implants that support the occluded artery for 6 mo and are completely resorbed in 2 years, leaving behind a regenerated artery. Clinical trials of BVS's report restoration of arterial vasomotion and elimination of serious complications of metal stents that occur 5 to 7 yr after implantation. It is remarkable that a scaffold made from PLLA, known as a brittle polymer, does not fracture when crimped onto a balloon catheter or during deployment in the artery. We used X-ray micro-diffraction to discover how PLLA acquired ductile character and found that the crimping process creates localized regions of extreme anisotropy. The degree and direction of orientation and crystallinity change on micron-scale distances. The distinct morphologies in the crimped scaffold work in tandem to enable a low-stress response during deployment, which avoids fracture of the PLLA hoops and leaves them with the strength needed to support the artery. After deployment, the highly oriented morphology created at points of stress localization during crimping confer resistance to hydrolysis precisely where it is needed for the scaffold to retain strength even after 9 mo of hydrolysis. Thus, the ability to use processing to access non-equilibrium microstructures in the semicrystalline PLLA are essential to the clinically-approved BVS and open the way to thinner resorbable scaffolds in the future.



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