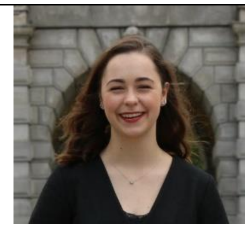
ESR 8

Project title and research strand:	Bio-based fibre-reinforced aortic heart valve. Strand 2: Fibres for medical application.	
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Abstract

Current heart valve replacements meet only partially the clinical demands for patients in need of such a device. Low functionality span, calcification, hemocompatibility issues, and in particular, the need of life-long surgeries for pediatric patients are commonly encountered issues. Therefore, there is a pressing need for advanced replacement solutions. In this study, we tackle this necessity by designing aortic heart valves endowed with customized fiber reinforcements and hydrogel matrix, both purely fabricated from native-like silk fibroin. To predict the mechanical behavior of these innovative scaffolds, a mathematical model is employed, utilizing the properties of the scaffolds' constituent materials, and experimentally validated through tensile testing. Valve hemodynamics of biomimetic rational-designed configurations were thoroughly assessed mechanically, and hemodynamically in accordance to ISO 5840 guidelines. Valves demonstrated compliant acute hemodynamic performance under aortic, as well as favorable biocompatibility based on in cytocompatibility studies. The developed silk fibroin-based aortic heart valve shows promise as a novel replacement solution to address the limitations of current surgical standards.

Visual Summary – Poster