Novel Composite Surgical Sealants for Cardiovascular Applications

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The use of bioadhesives and sealants for wound closure and healing applications is becoming more and more popular, particularly when other techniques, such as stapling or suturing, are impractical or inefficient. Loading adhesives with fibers has tremendous potential for improving their mechanical properties. The concept of fiber-reinforced bioadhesives and sealants is novel and has not been investigated to date. In the present study, natural cellulose fibers were selected for enhancement of bioadhesive properties. A bioadhesive formulation based on a combination of gelatin and alginate crosslinked with water-soluble carbodiimide was used as a generic formulation for this study, based on our previous studies. The polymeric matrix and the cellulose fibers showed high affinity which resulted in a dramatic increase in the viscosity and in the burst strength. They moderately affected the curing time, swelling and weight loss. A mixed response was found in the compression modulus and the bonding strength in lap shear. We demonstrated that fiber-reinforced bioadhesives have a great potential for surgical sealant applications due to improvement in the cohesive strength of the composite hydrogel. This study presents proof of the concept of using fibers for the enhancement of bioadhesive properties as a result of fiber-reinforcement and may comprise the basis for future studies in this field. The Figure below summarizes the fiber's effects on the mechanical and physical properties.

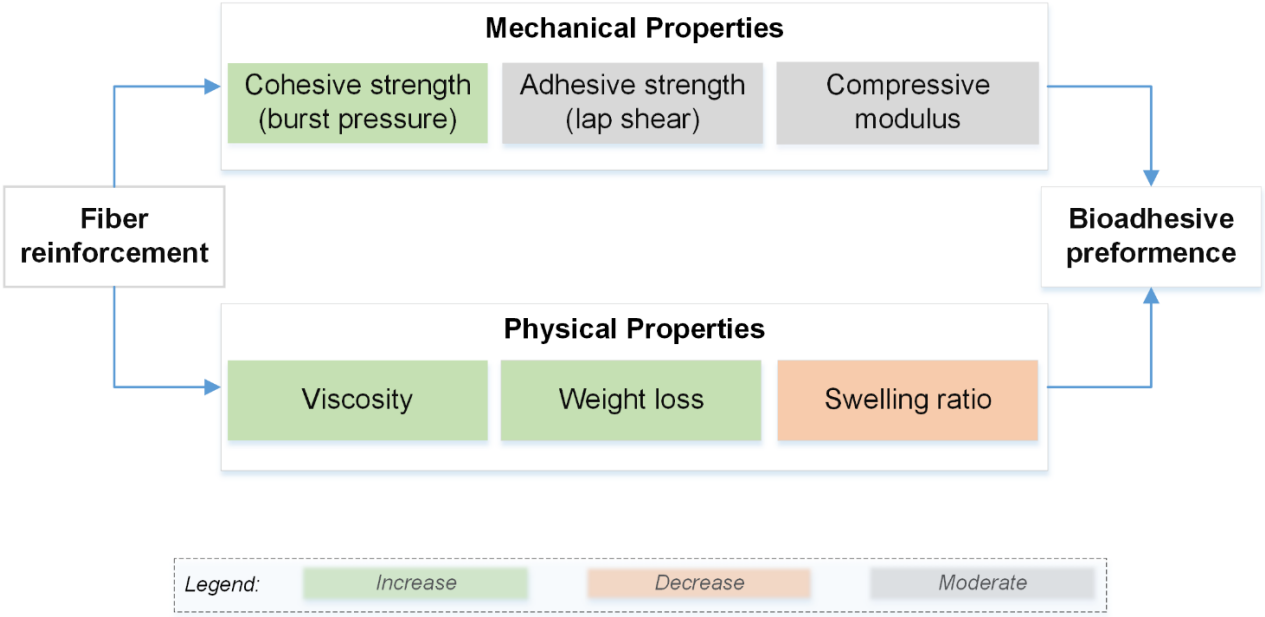

Figure: Schematic representation of a qualitative model summarizing the effects of CF incorporation on the bioadhesive's properties. The green/red boxes represent a case where the fibers' incorporation leads to an increase/decrease in certain properties, respectively. Grey boxes represent a mixed response.