Optimizing Hydrogel Synthesis for Customized Applications: An Interactive App for Practitioners

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Abstract

The use of hydrogels is rapidly expanding nowadays due to their broad applicability across various fields of knowledge. The role of these materials and their smart properties are revolutionizing regenerative medicine and biotechnology, to name a few, by enabling controlled drug release and tissue regeneration. In addition, their stimulus-responsive behavior is opening new frontiers in diverse areas such as soft robotics and sustainable development.

However, the widespread adoption of hydrogels faces a major challenge: the complexity of their synthesis. On the one hand, synthesis is often performed by non-experts due to the multidisciplinary nature of the teams developing these materials. On the other hand, even when an expert is available, the common practice of trial-anderror entails significant consumption of both financial and human resources.

The tool proposed in this study presents a significant advancement in the field of hydrogel synthesis, offering an open-access and user-friendly solution that eliminates the need for expert knowledge. Additionally, it enables the optimization of synthesis composition by considering the unique characteristics of each problem and laboratory constraints, all without requiring preliminary experiments. This results in a substantial reduction in both time and experimental costs. Furthermore, the feedback system implemented in the application marks the first step toward the development of an artificial intelligence system that would integrate expanded and up-to-date knowledge, representing a significant advancement in material synthesis.