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Design to Regenerative Medicine and Beyond: The Self-assembly of Supramolecular-covalent Peptides

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Introduction

The intersection of design principles and regenerative medicine has given rise to a fascinating field known as supramolecular-covalent peptide assembly. This innovative approach harnesses the power of both non-covalent interactions and covalent bonds to create sophisticated molecular structures with remarkable properties. From self-healing materials to tissue engineering scaffolds, the applications of these peptides extend far beyond conventional biomaterials. In this article, we delve into the intricacies of supramolecular-covalent peptide design, exploring its evolution, current state-of-the-art developments, and potential future directions in regenerative medicine and beyond [1].

As researchers continue to unravel the intricacies of supramolecular-covalent peptide design, new opportunities emerge for addressing complex biomedical challenges. From engineering functional tissues to designing next-generation therapeutics, the marriage of design principles and regenerative medicine holds immense potential for transforming healthcare and beyond [2].

Description

At the heart of supramolecular-covalent peptide assembly lies the synergy between non-covalent interactions, such as hydrogen bonding, π-π stacking, and electrostatic forces, and covalent bonds, which provide structural stability and permanence. This unique combination allows for the creation of dynamic yet robust biomaterials with tailored properties. One of the key features of these peptides is their ability to self-assemble into well-defined nanostructures and higher-order architectures. This self-assembly process is driven by the complementary interactions between peptide building blocks, leading to the formation of hierarchical structures ranging from nanofibers to hydrogels. The precise control over the assembly process enables researchers to design materials with specific mechanical, structural, and biological properties [3].

In addition to their structural versatility, supramolecular-covalent peptides exhibit dynamic behavior, allowing them to respond to external stimuli such as pH, temperature, and enzymes. This responsiveness opens up avenues for designing smart biomaterials that can undergo reversible structural changes or release bioactive molecules in a controlled manner. The applications of supramolecular-covalent peptides span a wide range of biomedical fields. In tissue engineering, these peptides serve as scaffolds for cell growth and tissue regeneration. Their bioactivity and biocompatibility make them ideal candidates for creating synthetic extracellular matrices that mimic the native tissue microenvironment. By incorporating bioactive motifs or signaling molecules into the peptide sequences, researchers can further enhance their regenerative properties [4].

Moreover, supramolecular-covalent peptides hold promise in drug delivery systems. Their ability to encapsulate and release therapeutic agents with tunable kinetics and targeting capabilities addresses key challenges in drug delivery, such as improving bioavailability and minimizing off-target effects. The dynamic nature of these peptides allows for on-demand release of drugs in response to specific biological cues, offering precise control over therapeutic interventions. Beyond biomedical applications, supramolecular-covalent peptides are paving the way for advancements in materials science. Their self-healing properties, arising from dynamic non-covalent interactions, enable the development of resilient materials that can repair damage autonomously. This has implications for creating durable coatings, adhesives, and structural materials with enhanced longevity and performance [5].

Conclusion

The field of supramolecular-covalent peptide assembly represents a convergence of design innovation and biomedical engineering, offering versatile solutions for regenerative medicine and beyond. By harnessing the power of non-covalent interactions and covalent bonds, researchers have unlocked a wealth of possibilities in creating biomaterials with tailored properties and functionalities. From self-assembling scaffolds to dynamic drug delivery systems, the applications of these peptides are poised to impact diverse areas of healthcare and materials science.

Looking ahead, further advancements in peptide design, characterization techniques, and computational modeling will fuel the development of more complex and functional materials. Integration with emerging technologies such as 3D bioprinting and genome editing holds promise for creating personalized therapies and tissue constructs with unprecedented precision.

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Conflict of Interest

None.

References

1. Zou, Pengfei, Wen-Ting Chen, Tongyi Sun and Yuanyuan Gao, et al. "Recent advances: Peptides and self-assembled peptide-nanosystems for antimicrobial therapy and diagnosis." Biomaterial Sci 8 (2020): 4975-4996.
2. Zottig, Ximena, Soultan Al-Halifa, Mélanie Côté-Cyr and Cynthia Calzas, et al. "Self-assembled peptide nanorod vaccine confers protection against influenza A virus." *Biomaterial* 269 (2021): 120672.
3. Pugliese, Raffaele and Fabrizio Gelain. "Peptidic biomaterials: From self-assembling to regenerative medicine." *Trends Biotechnol* 35 (2017): 145-158.
4. Afami, Marina E., Ikhlas El Karim, Imad About and Anna D. Krasnodembskaya, et al. "Multicomponent peptide hydrogels as an innovative platform for cell-based tissue engineering in the dental pulp." *Pharmaceutic* 13 (2021): 1575.
5. Jones, Lyn H., Arjun Narayanan and Erik C. Hett. "Understanding and applying tyrosine biochemical diversity." *Mol BioSys* 10 (2014): 952-969.

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