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Transformational Potential of Urbanisation Based on Biomimicry Notions

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INTRODUCTION & AIM

The rapid pace of urbanization coupled with the escalating challenges of climate change has necessitated a paradigm shift in urban development strategies. Traditional approaches often fall short in addressing the complex interplay between urban growth and environmental sustainability. In this context, the integration of biomimicry principles emerges as a promising avenue for reimagining urban landscapes. Biomimicry, derived from nature's ingenious designs and processes, offers a blueprint for creating cities that are not only resilient to climate change but also harmonious with the natural world. By emulating nature's time-tested solutions, cities can potentially unlock innovative approaches to climate adaptation, resource efficiency, and sustainable development. This introduction sets the stage for exploring the transformative potential of biomimicry in shaping the future of urban environments.

The primary aim of this study is to delve into the application of biomimicry concepts in urban settings to enhance sustainability, resilience, and adaptability. By investigating the effectiveness of biomimicry in urban design and development, the research seeks to uncover how nature-inspired solutions can address the pressing challenges faced by cities in the era of climate change. Through a comprehensive analysis of contemporary biomimetic solutions, such as structural organization inspired by honeycombs and adhesive techniques inspired by geckos, the study aims to evaluate the impacts of biomimicry on urban materials, structures, and systems. By combining interdisciplinary research and literature reviews, the research endeavors to reveal the untapped potential of biomimicry in urban evolution, offering insights into how cities can leverage nature's wisdom to create adaptive solutions that align with the equilibrium of natural ecosystems. Ultimately, the study aims to provide a foundation for future research and practical applications of biomimicry principles in urban planning and design, paving the way for more sustainable, resilient, and ecologically sensitive cities.

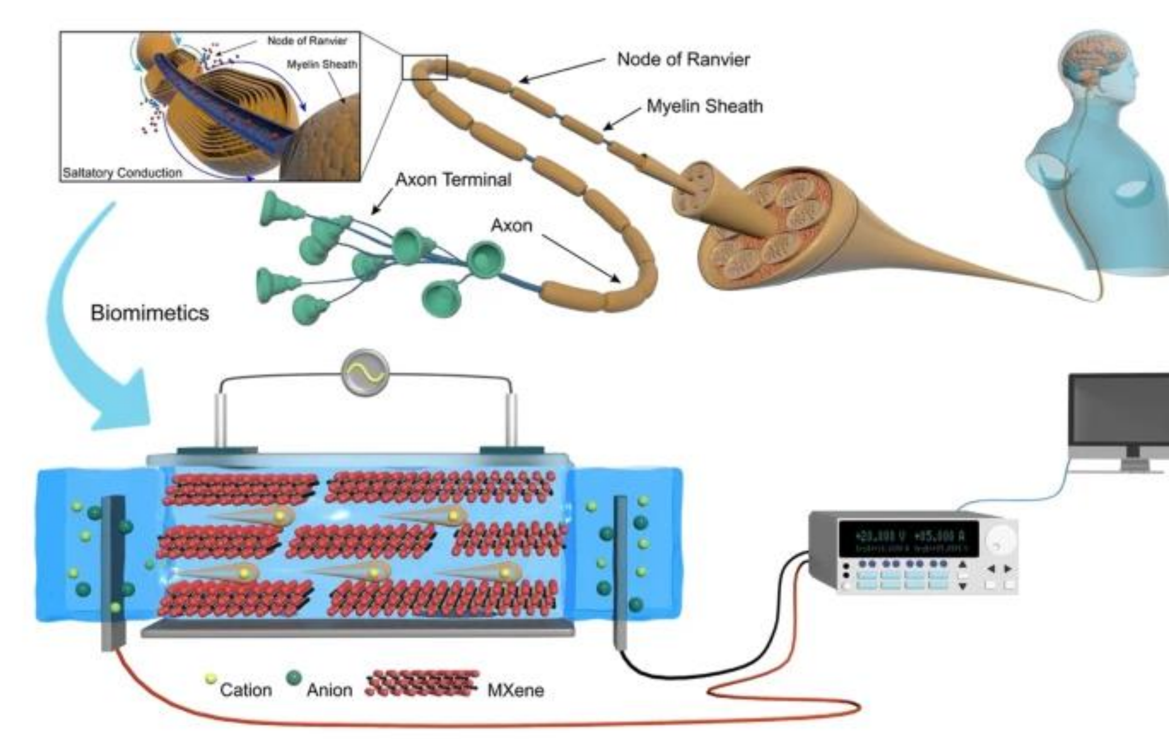
METHOD

- The initial step in biomimetic materials research is the identification of a useful principle in a natural material. Interestingly, the “simple” (less developed) organisms provide exploitable concepts of bioinspiration. One of the greatest qualities of natural materials is that they are based on structuring rather than on the use of different constituent materials. Engineering materials, on the contrary, typically have quite simple structures, but they are produced with virtually any imaginable chemical composition.

- Biotemplating combines the structuring principles observed in natural materials with the versatility of engineering materials, allowing for the creation of materials with unique structures and morphologies. This approach leverages the hierarchical structuring found in natural materials, which often results in superior functional properties despite being composed of relatively simple base substances. By mimicking the structuring principles of natural materials, biotemplating enables the synthesis of materials with enhanced properties that go beyond what traditional engineering materials can offer (Burgert & Fratzl, 2009).

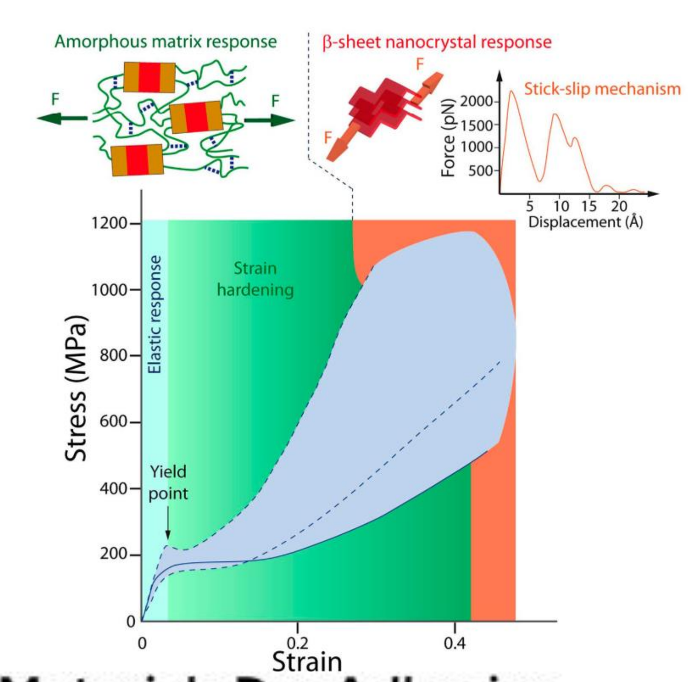
- The concept of biotemplating represents a convergence of the sophisticated structuring of natural materials and the diverse chemical compositions achievable in engineering materials. This innovative approach opens up new possibilities for material design, combining the best of both worlds to create advanced materials with tailored properties and functionalities. By drawing inspiration from nature's structuring strategies and combining them with the flexibility of engineered materials, biotemplating offers a pathway to develop materials that exhibit unique combinations of structural complexity and chemical composition, leading to a new era of biomimetic material synthesis (Paris & Fratzl, 2010; Barthlott & Neinhuis, 1997; Meyers et al., 2008; Deng et al., 2017; Liska & Paris, 2019; Fratzl, 2003; Paris, Burgert, & Fratzl, n.d.)

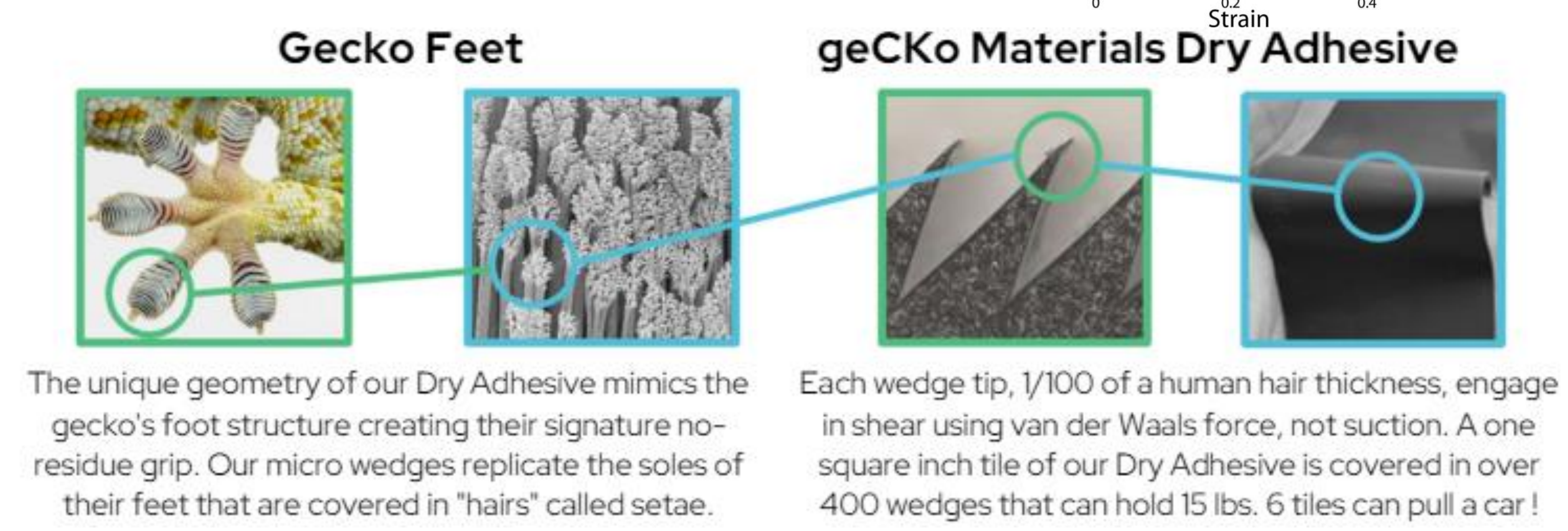
RESULTS & DISCUSSION



The neural saltatory conduction along axons is a unique action potential propagation pattern limited to myelinated axons, demonstrating ultrafast signal transmission. The bioinspired nervous signal transmission system is a 2D MXene nanofluidic device with signal input and acquisition modules, enabling real-time current feedback and signal transmission.

The tensile properties of Major Ampullate (MA) silk exhibit a multi-regime, non-linear mechanical behavior. At low strain, the amorphous phase governs the response, transitioning to β-sheets dominance at high strain. The elastic regime involves reversible deformation of the amorphous matrix, followed by untangling of amorphous domains and β-sheet involvement, leading to strain hardening. Prior to failure, slip-stick behavior of β-sheets enhances silk's resistance to elongation, contributing to its mechanical strength.





CONCLUSION

In conclusion, Biomimetic the study of natural systems to inspire engineering and design, holds great potential for sustainable innovation. By mimicking nature's designs and processes, we can develop materials and structures that are efficient, adaptable, and sustainable. In construction, biomimetic materials such as wood offer high-performance properties, while natural algorithms can inspire more efficient algorithms for machine learning and artificial intelligence.

FUTURE WORK / REFERENCES

Schroeder, T. B. H., Guha, A., Lamoureux, A., VanRenterghem, G., Sept, D., Shtein, M., … Mayer, M. (2017). *An electric-eel-inspired soft power source from stacked hydrogels. Nature, 552(7684), 214–218.* doi:10.1038/nature24670

Spider silk as a blueprint for greener materials: a review