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Metamaterials offer promising new functionalities for orthopedic implants **FREE**

Avery Thompson



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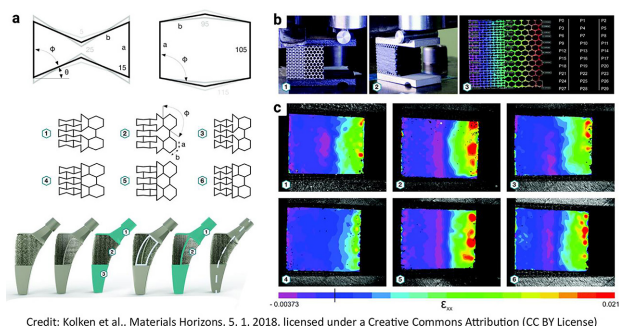


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Unique properties exhibited by composite materials could lead to stronger, cheaper, more customizable implants.



Credit: Kolken et al., *Materials Horizons*, 5, 1, 2018, licensed under a Creative Commons Attribution (CC BY License)

Recent decades have seen a surge in applications for metamaterials, which exhibit unique properties in optics, acoustics, mechanics, and other areas. The composite nature of these materials and their complex structures create new possibilities in many disciplines.

Some of these possibilities include enhanced medical implants, thanks to the recent development of meta-biomaterials. Mirzaali and Zadpoor discussed the emerging field of orthopedic meta-implants and proposed directions for future study.

“These implants offer rare, if not unprecedented, combinations of multiple functionalities and exploit similarly rare or unprecedented combinations of mechanical, physical, and biological properties to present unique solutions for the treatment of skeletal diseases, particularly those for which no conventional solutions currently exist,” said author Amir Zadpoor.

Because these biomaterials are composites, orthopedic meta-implants can be tailored to mimic the properties of bone. Some materials possess unique mechanical properties, like a negative Poisson’s ratio, that enable stronger, more durable designs. Other materials can be molded or shaped for each patient, and some implants feature deployability that allows them to be inserted into the body via minimally invasive surgeries before expanding to their full size.

Although these meta-implants are promising, the authors caution that several challenges still prevent practical use. Tools and methods will be needed to sort through the large variety of materials and material combinations, and an ethical and regulatory framework must be developed.

Still, the researchers are optimistic about the future of this growing field.

“Incorporating these materials into real clinical applications is an aspect we are eagerly anticipating,” said author Mohammad Mirzaali. “Due to the unique features of these meta-biomaterials, we foresee a new era marked by more personalized treatments.”

Source: “Orthopedic meta-implants,” by Mohammad J. Mirzaali and Amir Abbas Zadpoor, *APL Bioengineering* (2024). The article can be accessed at <https://doi.org/10.1063/5.0179908>.

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