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Enhanced conformability of protective equipment with a negative Poisson's ratio

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Auxetic materials have a negative Poisson's ratio (NPR), when subject to deformation they exhibit interesting characteristics, that have shown potential for protective sportswear; these materials laterally expand under stretch and laterally shrink under compression. The conformability of auxetic foam is owed to its excellent shape fitting ability on a curved surface through the formation of synclastic curvature under pure bending as well as biaxial expansion. These qualities could enhance the current standard of protective equipment, as a key challenge for designers of impact protective clothing is to create garments that allow people to work and play effectively. Foam components are embedded within personal protective equipment (PPE) for sports apparel, where protective material is positioned at regions of the body frequently exposed to injury of the soft tissue through collision, fall or hard impact. Current protective materials can inhibit movement, breathability and wicking, whilst moulded pads are prone to saddling. Research has not yet determined whether the impact performance of auxetic materials is hindered under a state of synclastic curvature or biaxial expansion. One of the main benefits of using auxetic equipment for apparel is in exploiting its ability to conform to curved body regions such as the shoulder and extend with stretch fabrics and body movements rather than restrict them. Under a state of synclastic curvature and biaxial expansion, the structure of an auxetic material is subject to unhinge or unravel. Therefore, it is critical to assess the impact attenuation under synclastic curvature and biaxial expansion of a selection of auxetic materials versus conventional alternatives, including foams and 3D prints. The outcomes of this research will contribute to knowledge of the potential application of auxetic materials in sports apparel.

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