Technology offer

Axisymmetric chiral auxetic structure

Field of use
Engineering, medicine, and sports.

Current state of technology
Stage of Development:
Available for demonstration

Patent status
Patent pending

Developed by
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Background

The present invention relates to an axisymmetric chiral auxetic structure. The invention belongs to the field of materials design. The invention is an axisymmetric chiral cellular structure with a cylindrical or spherical shape consisting of equal or variable unit chiral cells. The structure exhibits auxetic deformation behaviour with negative Poisson's ratio in all polar or spherical coordinate directions upon mechanical loading. The deformation of the cylindrical chiral auxetic structure is isotropic in the radial direction under axial loading.

Description of the invention

An axisymmetric chiral auxetic structure, characterized in that it is assembled from chiral unit cells, which are axisymmetrically uniformly or non-uniformly distributed in space to form a cylindrical or a spherical shape; the chiral cells have curved struts, which connect in nodes, wherein outer surfaces of unit cells may be solid, thereby forming closed cells or channels in the structure.

The structures shrink in the transverse direction at longitudinal compressive loading (the volume is significantly reduced), while the structures expand in the transverse direction at longitudinal tensile loading (the volume is thereby significantly increased). This is a consequence of the carefully designed deformation mechanism of the structure unit cells, which depends on cell porosity. Multifunctional cellular structures may be upgraded by introducing the auxetic deformation concept, leading to increased shear stiffness and energy absorption and altered response to bending loads, increasing their use in different fields of engineering, medicine, and sports.

Several types of two- and three-dimensional auxetic structures have been developed so far. Their geometry is based on unit cells, which periodically repeat in space and form a cellular structure. The morphology of cells defines their size, shape and closed or open shape. The unit cell in the present invention has a chiral shape derived from on analysis of inherent

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frequencies of non-auxetic cellular structures, where curved struts or surfaces connect at nodes (corners) of the unit cell.

Main advantages

The axisymmetric chiral auxetic structures may be used as i) support in a pipe or a tube, for maintaining the inner cross-section or flow at folds (synclastic response at bending), ii) a filler for profiles with circular inner cross-sections, iii) a wrap (outer layer) of profiles with circular outer cross-section, iv) filter with variable characteristics, v) as a bumper or energy absorber, vi) an air-free or non-inflatable product (i.e. a tire, a ball), vii) a heat conductor, viii) an insulator.

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