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Development and Characterization of Re-Entrant Auxetic Fibrous Structures for Application in Ballistic Composites

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Abstract : Auxetic fibrous structures and composites with negative Poisson’s ratio (NPR) have huge potential for application in ballistic protection due to their high energy absorption and excellent impact resistance. In the present research, re-entrant lozenge auxetic fibrous structures were produced through weft knitting technology using high performance polyamide and para-aramid fibres. Fabric structural parameters (e.g. loop length) and machine parameters (e.g. take down load) were varied in order to investigate their influence on the auxetic behaviours of the produced structures. These auxetic structures were then impregnated with two types of polymeric resins (epoxy and polyester) to produce composite materials, which were subsequently characterized for the auxetic behaviour. It was observed that the knitted fabrics produced using the polyamide yarns exhibited NPR over a wide deformation range, which was strongly dependant on the loop length and take down load. The polymeric composites produced from the auxetic fabrics also showed good auxetic property, which was superior in case of the polyester matrix. The experimental results suggested that these composites made from the auxetic fibrous structures can be properly designed to find potential use in the body amours for personal protection applications.

Keywords : auxetic fabrics, high performance, composites, energy absorption, impact resistance
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