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Design and Manufacturing of Long Fiber Thermoplastic Composite Helmet Insert

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**Design and Manufacturing of Long Fiber Thermoplastic Composite Helmet Insert**Haibin Ning<sup>a\*</sup>, Selvam Pillay<sup>a</sup>, K. Balaji Thattai parthasarathy<sup>b</sup>, and Uday K. Vaidya<sup>c</sup><sup>a</sup>Department of Materials Science and Engineering,  
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## Abstract

Long fiber thermoplastic composite (LFT) is one type of thermoplastic polymer matrix composites reinforced with discontinuous fibers above critical fiber length. It has been increasingly used in various applications due to its excellent specific strength and specific modulus in addition to its infinite shelf life, intrinsic recyclability, and high-volume processability even for complex geometries. In this work, long carbon fiber reinforced polyphenylene sulphide (LFT C/PPS) is used to prototype a helmet insert with high rigidity for stiffening a relatively soft ballistic shell. The helmet insert is designed to have a rim along its periphery in order to offer extra rigidity and facilitate a readily clip-on with the ballistic shell. Static structural analysis is carried out for evaluating the performance of the insert. Comparison was made among different patterns of the helmet insert in their rigidity. A compression molding tool is designed and machined and the helmet insert is prototyped using LFT C/PPS. A compression test is conducted for the ballistic shell integrated with the helmet insert to validate the stiffening capability of the LFT C/PPS helmet insert.

**Key words:** Composites, Long fiber; thermoplastics; helmet insert; compression molding\*Corresponding author: Haibin Ning; [ning@uab.edu](mailto:ning@uab.edu); 205-996-7390

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