

Ballistic Protection Vest with Graphene-and-Silica-Aerogel-Enhanced Lightweight Panels and an Integrated Pressure-Sensitive Layer

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Abstract: The project goal was to carry out research in order to create new knowledge and develop a technological solution for enabling additional functional qualities in textiles by improving their protective and ballistic properties by Nano-level modifications and the integration of a pressure-sensing layer for determining the position and/or pressure of the applied force, with the ultimate goal of reducing overall weight, and adding smart functions such as remote vitality evaluation and/or impact data acquisition for use as Personal Ballistic Protective Equipment.

Keywords: Ballistic Protection Vest, Soft Ballistic Panels, Graphene-and-Silica-Aerogel, Piezoresistive Sensor

Research of Ballistic Protection Vest (BPV) soft panels constructions in use by the Latvian Army and assessment of their compliance with National Institute of Justice (NIJ) Standard 0101.06 and 0101.07 [1] Ballistic Resistance of Body Armor requirements was carried out.

Based on the requirements of NIJ standard for the planar configuration, minimum and maximum size of the BPV soft panels and area limit values, as well as standard accompanying official U.S. Department of Justice Office of Justice Programs, NIJ recommendations [2].

A multi-layer piezoresistive sensor for high energy dynamic impact detection has been developed. Conductive traces of the sensor are made using conductive threads and embroidery technology.

High-speed electronic system has been developed for reading sensor's data. The sensor is sampled more than 70000 times per second, which gives enough data points to determine not only the energy of the impact, but also the impactor's speed.

BPV prototype with graphene-and-silica aerogel-enhanced lightweight panels and an integrated pressure sensitive layer for multi-zone impact detection, two types of BPV Soft Panels (BPVSP) (for outer garment and for undergarment) in 16 various Central European soldier (male) sizes have been designed and a methodology for constructing outer garment and undergarment BPV soft panels has been developed. The new BAV was developed by improving its modularity, aligning the

selection of raw materials [3] with the requirements of the NIJ standards and the recommendations of their supporting documents, as well as considering the recommendations of Latvian Army and current requirements for more comfortable use to facilitate the performance of daily tasks.

The design of new Modular BPV includes the detachable parts, that can be changed or modified for the particular mission; all parts are accommodate both BPVSP and Hard Ballistic Protection Plates; all parts are available in different sizes with possibility to combine with each other and to adapt for different body proportions to create a customized armor carriage vest.



Figure 1 Modular Ballistic Protection Vest prototype

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