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JAN-ANDERS MANSSON - PURDUE UNIVERSITY

COMPOSITES IN SPORTS

A TESTBED FOR CUTTING-EDGE TECHNOLOGIES

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ABSTRACT

The use of new materials to enhance sports performance is inevitable, and the development of sports equipment and apparel stands as a significant industry. Frequently, cutting-edge materials like composites find extensive use in sports equipment and are often introduced on the playing field long before they make their debut in industries like aerospace or automotive. The pace of technological evolution in the sports performance market is second only to consumer electronics and fashion, both of which operate at an even more accelerated rate. This complementarity and synergy in implementation dynamics create significant opportunities for efficient technology exchange, mutually benefiting the industrialization of new innovative materials and technologies.

Composite materials are favored in sports equipment for their exceptional stiffness-to-weight ratio and rapid energy conversion and restitution capabilities, vital for optimizing and maximizing performance output. These advanced technologies not only enhance performance but also elevate athlete safety and comfort. Tailored damping and related injury prevention measures are achieved and realized through material properties and designed energy absorption strategies.

The striving for increased stiffness while minimizing the weight of composite materials can often lead to equipment brittleness, which may induce premature fractures and dangerous fracture surfaces that are harmful to athletes and pose a threat to their safety. This holds true for certain carbon fiber bicycle frames and wheels. Reduced weight and mass may increase accelerations and lead to higher speeds, potentially compromising trajectory control and transferring excessive kinetic energy to the body's ligaments and tissues. Fast energy restitution, even though a highly valued feature in sports equipment, automatically reduces damping and consequently increases the impact on the body.

Athletes are renowned for their exceptional capacity to develop a unique ability to meticulously analyze, assess, and quantify their performance and its intricate relationship with their equipment and environment. This offers scientists an opportunity to grasp the development of athletes' sensory and control abilities. Integrating engineering sciences and life sciences in the field of sports thus opens new horizons for a broader range of applications, enhancing performance, comfort, safety, and injury prevention. While the primary focus of study is often on expert athletes, many findings are directly applicable and beneficial to everyday athletes, influencing and improving our overall quality of life.

The introduction of 'smart' and functional materials, development of embedded sensors, along with cutting-edge measurement, control, and performance evaluation technologies, has recently reached new heights when incorporated into apparel and equipment. This innovation has not only enhanced performance but also introduced exciting new features for an immersive real-time fan experience.



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B I O

Jan-Anders Mansson is a distinguished professor of Engineering at Purdue University. He holds a PhD in Polymer and Composites from Chalmers University in Sweden and has held leadership roles and professorships at several prestigious global institutions, including vice president of EPFL and President of AISTS in Lausanne, Switzerland. His extensive research portfolio spans over 400 publications, several books, and multiple patents, all of which have made a significant impact in the field. His research focuses on the development of innovative materials and their applications, with a broad range of interests spanning from aerospace and automotive to sports and bio-engineering. Dr. Mansson has been a pioneer in the sports engineering field and used his knowledge and research to found the Sports Innovation Center at Purdue University (RESEC). Over the years he has also worked closely with several international sport organizations including the International Olympic Committee (IOC). Dr. Mansson is member of the Engineering Science Academies of Sweden (IVA) and Switzerland (SATW), and fellow in numerous professional societies. Dr. Mansson's research is recognized internationally for its impact, making him a mentor and source of inspiration to many young researchers in the Engineering and Science of new Material and Sports.