

A SELF-HEALING SYSTEM FOR THE SOLES OF ALL RUBBER PROTECTIVE FOOTWEAR

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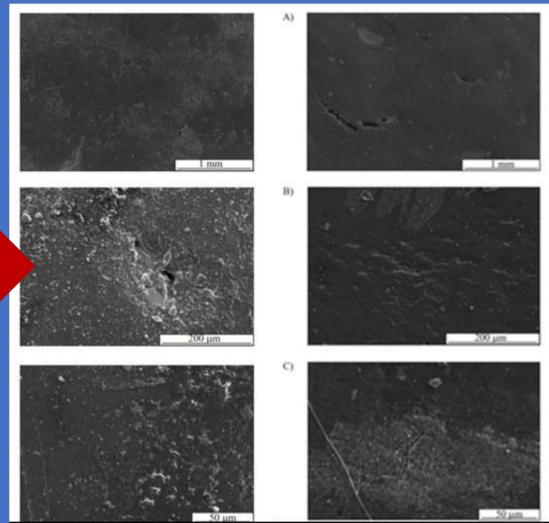
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The objective of work was to improve the safety performance of protective footwear by increasing its service time using next-generation polymeric materials featuring autonomous self-healing mechanisms capable of repairing mechanical defects in a sole structure without an external intervention. Some mechanical defects naturally occur in the structure of personal protective equipment in the course of its normal use. While initially those defects are often not visible and difficult to detect, they may compromise polymeric materials and over time lead to permanent damage and shorter service times.

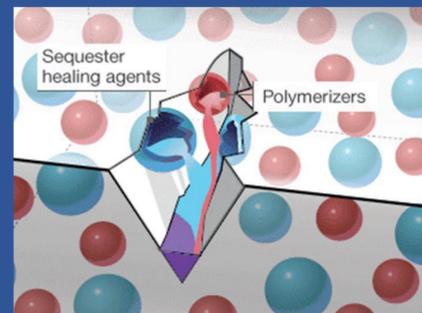
Mechanical factors during use

Degradation of materials during use

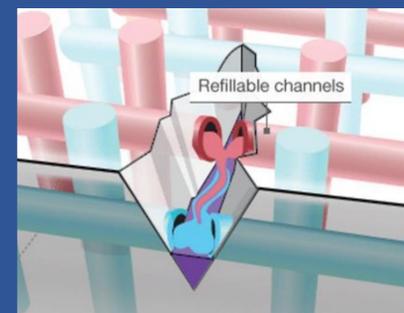
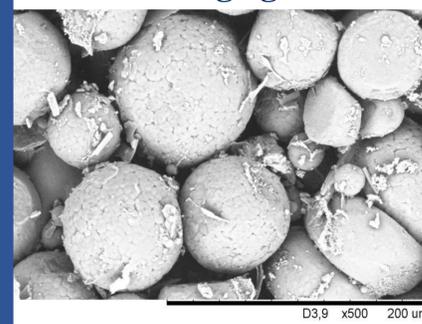


The applied autonomous self-healing mechanisms (ASMs) have the capacity of immediate material regeneration without the external intervention. The first ASM involves a microencapsulated monomer released in the case of damage to fill the resulting defect in the sole. The other ASM involves the implementation of a network of channels supplying the monomer to the damaged area.

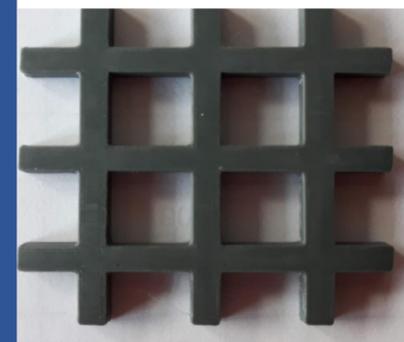
Extrinsic self-healing systems



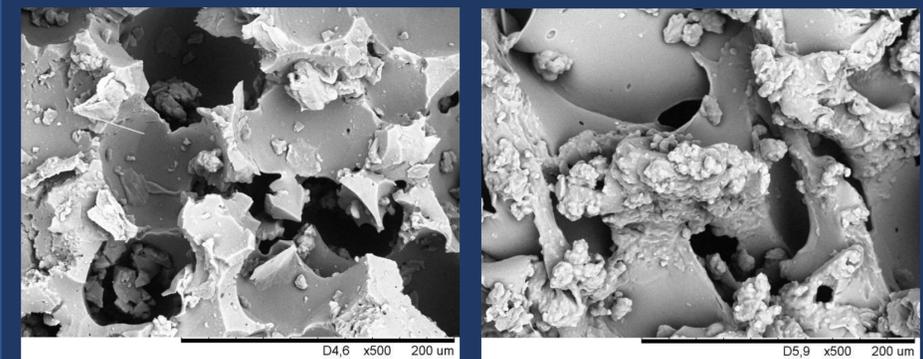
Micro-encapsulation of healing agent



Micro vascular network



Photomicrographs of the surface morphology of sole samples and sole with microcapsules.



The conducted research confirmed the possibility of applying self-healing mechanisms to the construction of protective footwear. The self-healing process was also proven effective with safety shoes in response to damage. The new approach applied in this work may be a useful tool in improving the safety of workers using the polymeric protective footwear in the context of sole wear. Our results constitute the first step towards a better understanding of the effects of self-healing systems on estimating the service life of soles in all-rubber footwear.

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- [2] Council Directive 89/656/EEC of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace (third individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
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