Immobilization of Natural Bioactive Compounds onto Biopolymeric Surfaces

Norma Mallegni, Serena Coiai, Francesca Cicogna, Elisa Passaglia

The immobilization of bioactive molecules of natural origin on polymeric surfaces offers a promising strategy for developing advanced materials with antimicrobial and antioxidant functionalities. This approach enables the development of functional surfaces and materials, suitable for a variety of applications, including textile finishing and active packaging. Polyphenols[1,2] is among the most promising natural bioactive compounds and can be sustainably extracted from agri-food waste. These molecules have been successfully incorporated into bioplastics[3,4], leading to the development of innovative and environmentally friendly materials. In this presentation, I will describe recent advancements in our research. Specifically, I will present an innovative strategy developed by our group to functionalize PLA-based nonwoven fabrics (NWFs)[5] using cold plasma treatments with oxygen and oxygen–argon gas mixtures. This surface modification significantly enhances the adhesion of bioactive compounds—such as epigallocatechin gallate (EGCG) extracted from green tea, well known for its antioxidant properties—thus paving the way for sustainable applications in biomedical, cosmetic, and food packaging sectors. Notably, plasma treatment plays a crucial role in this process by increasing the surface reactivity of polymers, thereby facilitating the attachment of bioactive molecules or functional intermediates. It is a cost-effective and tunable technique, easily adaptable through precise control of process parameters. Overall, this methodology enables the design of multifunctional materials, where antioxidant and antibacterial properties of natural biomolecules can enhance material performance and, depending on the application, may also provide therapeutic potential. This strategy not only supports the principles of circular economy but also delivers high-performance solutions for active packaging, cosmetics, and biomedical applications.

References

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