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Bioactive nanofibrous systems based on natural materials

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Acute or chronic wounds affect millions of people annually and their incidence is expected to increase in the next years mainly due to the growth and aging of global population. The next generation of wound dressings should be able to promote the regeneration of the injured skin instead of just protecting it. In fact, one of the main limitations of the current devices is the lack of multi-functionality. This suggests that the dressings of the future might be constituted by advanced materials that actively interact with the wound site releasing the specific active agent according to the conditions of the wound. Here, we present the development of bioactive dressings by combining biomaterials derived from natural resources and nanofabrication strategies. Composite scaffolds are produced by electrostatic spinning (namely the hydrodynamic extrusion of nanofibres by means of an electrical field) using biocompatible and biodegradable natural polymers, such as polysaccharides (alginate, cellulose). We demonstrated the effective encapsulation of active agents with antibacterial and healing activity (drugs and plant extracts) inside the electrospun nanofibers. We were able to regulate the degradation rate of the composite mats under physiological conditions, and the delivery over time of functional compounds. These templates mimic the organisation of the extracellular matrix and the structure of the human skin, fostering the proliferation and differentiation of cells. Furthermore, the ultrafine size of the fibres guarantees excellent conformability of the non-woven mat to the wound site, proving complete coverage of the injured tissue, and protection against infections and dehydration. The high porosity of the electrospun mesh facilitates the transport of nutrients and the absorption of exudates, together with the effective delivery of therapeutic substances.

Biography

Elisa Mele is currently Senior Lecturer in Biomaterials at the Department of Materials of Loughborough University (UK). Her research interests include: Biocompatible and natural polymers for regenerative medicine; Nanofibrous wound dressings with antimicrobial activity and enhanced cell proliferation; Functional nanocomposites with controlled superficial and mechanical properties; Microfluidic devices for biological assays and food safety; Nanofabrication approaches for polymers.

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