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Externally triggered on-demand drug release from stimuli-responsive hydrogel-based electrospun nanofibers and their composites

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Pulsatile drug delivery systems are gaining a lot of interest because of their numerous advantages, especially when compared to conventional pharmaceutical dosage forms [1]. These materials are time- and site-specific drug delivery systems which can minimize deleterious side effects of conventional drug administration systems. Nevertheless, the delivery systems that are of particular interest are the ones with reversible on-off switching capability, because they allow the delivery of therapeutic agents at the proper time after a predetermined lag time. Among the polymers used for biomedical applications, hydrogels are a class of materials of particular significance, because they can provide spatial and temporal control over the release of various types of drugs. Stimuli-responsive hydrogels can release drugs on-demand with a fast release rate through different mechanisms. The effectiveness of this process can be maximized using nanostructured materials with a large surface-area-to-volume ratio such as electrospun nanofibers.

Current challenges in the development of hydrogel electrospun fibrous nanomaterials lie in the lack of spinnability of pure hydrogel precursor solutions. Addressing this issue, we firstly designed a new core-shell nanofibrous material in which the poly(N-isopropylacrylamide)-derivative hydrogel is confined within a shell of a spinnable polymer (Figure 1a). Alternatively, we developed a scaffold material in which electrospun nanofibers loaded with different bioactive molecules where surrounded by a stimuli-responsive hydrogel (Figure 1b). Morphological and chemical characterization as well as drug release studies were carried out to confirm the material's ability to supply different doses of drugs on demand and to study the release mechanism.

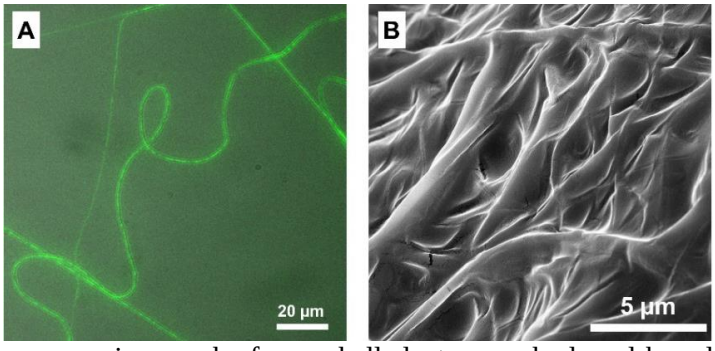

Figure 1: (a) Fluorescence micrograph of core-shell electrospun hydrogel-based fibers; **(b)** scanning electron micrograph of an electrospun nanofibrous mat surrounded by a stimuli-responsive hydrogel.

Key Words: Electrospun nanofibers, On-demand drug delivery system, Stimuli-responsive nanomaterials, Hydrogels.

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