Photothermally Accelerated Drug Delivery Using Water Dissolvable Microneedle for Skin Recovery and Wound Healing

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Microneedle (MN) has shown the benefit of its ability to deliver the active ingredients and help skin absorb those without stimulating pain receptors and with enabling sustainable drug delivery. However, conventional non-soluble and rigid MNs has insufficient efficiency and controllability of molecular delivery. Herein, we propose stimuli-responsive MNs mainly composed of biocompatible hyaluronic acid as dissolvable polymer matrix and plasmonic gold nanoparticles (GNPs) as light-responsive materials for increasing efficiency. This hybrid MN is easily dissolved in response to moisture, which helps the loaded drugs release. In addition, the integrated GNPs induce local heat generation by the photothermal conversion effect under resonant light condition, enabling acceleration of drug release and its deep penetration. GF used as model drug was encapsulated by hydrogel particles to reduce denaturation and increase stability, and it is expected to help skin recovery and wound healing. We expect the proposed hybrid MN to be very useful in a variety of molecular delivery applications by providing a safe and effective platform with improved drug delivery efficiency and controllability.