DFA Dirección de Formación Académica

CENTRO DE INVESTIGACIONES EN OPTICA, A.C.

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Thesis: "DEVELOPMENT OF A GREEN OPTICAL PH SENSOR BASED ON NANOCELLULOSE FOR POSSIBLE APPLICATIONS IN WOUND MONITORING AS A SMART DRESSINGT"

Summary:

Chronic wounds, defined as wounds that are not healing in the proper time and manner, have severe economic, clinical, and humanistic consequences. Currently, timely diagnosis of a chronic wound is hampered because wounds are assessed for chronicity and infection relying mainly on visual examinations. As a countermeasure to this problem, novel smart dressings able to perform active monitoring of meaningful parameters of the wound healing status (e.g. pH, temperature, uric acid, biomarkers) have emerged. This monitoring of smart dressings requires wearable electrochemical or optical sensors. A pure optical wearable sensor (i.e., colorimetric or fluorometric) is more simple, intuitive, and tetherless. Nevertheless, current optical pH monitoring smart dressings are usually based on synthetic pH-responsive dyes or nanomaterials that require time-demanding synthesis processes, and high resource consumption. Hence, as a much simpler and greener alternative, herein, three natural pigment-based optical pH sensors embedded in a nanocellulose film are proposed.

The natural pigments used, i.e., chlorophyll, anthocyanins, and curcumin are extracted simply by solvent-extraction from spinach, red cabbage, and roselle, respectively, while the curcumin source is a commercial-grade turmeric powder. The optical pH-responsiveness of the pigment-rich extracts in a pH range of 3-10 was characterized by measuring their UV-vis absorption, emission, and excitation spectra. Moreover, the color coordinates in the CIE (Commission Internationale de l'éclairage) 1976 (L* a* b*) color space were calculated for each pH. These pH sensors have been pointed out as an excellent alternative for wound monitoring applications since they are composed solely of natural pigments and bacterial nanocellulose, which are not only recognized as biocompatible but also have been proved to have different valuable bioactivities and synergistic effects for wound healing. The three pigmentbased pH sensors provide a colorimetric, fluorometric, and visual assessment of the pH in a window of biological significance for wound healing (pH=4-9).