Diagnosis of burn severity using Terahertz spectroscopy

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Extended Abstract:

Noninvasive delineation of burn wounds remains a significant challenge, especially when access to highly-trained burn specialists is not available. Burns wounds can be stratified, according to the depth of the compromised tissue, into four clinically useful grades: epidermal, superficial partial-thickness, deep partial-thickness and full-thickness. While superficial partial-thickness burns can naturally heal without surgical intervention, full-thickness burns require excision and skin grafting procedures. Deep partial-thickness burns, however, can worsen and reach full-thickness depth over time. We present experimental results from the application of terahertz time-domain spectroscopy in differentiation of superficial partial-thickness, deep partial-thickness and full-thickness burns in standardized porcine and rodent animal model. Porcine burn models are clinically more accurate, and therefore are favored over other animal models such as rodents, because the skin regeneration in swine more closely represents the wound healing process in humans. We followed a previously standardized in vivo protocol that consistently creates scald burns of clinically relevant severity levels. We used various histological assays, including Vimentin Immunohistochemistry, to quantify the severity of burns according to the depth of the damaged skin by observing different biological viability markers. Statistical analysis of our results (n=9) indicate that the terahertz spectral information of the wound between 0.2 and 0.8 THz can be used to discriminate between burns of varying severity that will require different clinical treatment plans. Finally, we will discuss sources of terahertz signal contrast in both rodent and porcine skin including sensitivity of terahertz radiation to absorption by the water content of the tissue, which increases due to formation of interstitial edema at the burn site, as well as to the density of skin structures, which have the same size as the wavelength of the radiation.