110. Title: Terahertz-Wave Spectroscopy for Precise Histopathological Imaging of Tumor and Non-tumor Lesions in Paraffin Sections

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Abstract: Terahertz (THz; 10(12) Hz) waves have a frequency from 0.1 to 10 THz between the visible light and microwave domains. THz waves are expected to be useful for analysis of the histological features, without any staining procedure that is an indispensable prerequisite for optical microscopy. It has been demonstrated that THz transmittances at cancer and normal tissues are different. However, spectroscopy that is currently used is applicable for imaging only small areas at fixed-wavelength. In this study, we have developed a spectrometer employing a gallium phosphide (GaP) THz-generator and applied it to examine large areas of tissue specimens using a wide range of wavelengths. We thus examined the whole areas of two paraffin sections (metastatic liver cancer and acute myocardial infarction) in a frequency range of 1 to 6 THz, and compared the THz images of ordinary paraffin sections with the histological features detected by microscopy. THz imaging showed striking contrasts between cancerous and non-cancerous regions at 3.7 THz. Likewise, the precise imaging was achieved in the infarct myocardium at 3.6 THz. Images of THz transmittances in optimal wavelength were well matched with HE histological features both in cancer and myocardial tissues. Cancer regions showed higher transmittance than non-cancerous regions in liver. Old scar regions showed low transmittance, and necrotic regions showed relatively higher transmittance than normal myocardial areas. Thus, THz imaging precisely reflects tissue conditions such as tumor, non-tumor tissues, tissue degeneration and fibrosis. The newly established THz spectroscopy would be useful for pathological diagnosis of routinely processed specimens.