利用太赫兹波探索大脑奥秘

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太赫兹技术为脑部疾病的术中诊断提供了新的机会，医生凭借太赫兹技术可区分脑组织结构中的白质和灰质及其他具有不同组织液含量的神经血管结构。

俄罗斯科学院普罗霍罗夫普通物理研究所 Kirill Zaytsev 博士、天津大学徐德刚教授和俄罗斯萨拉托夫州立大学 Valery Tuchin 院士所在的研究团队概述了用于研究健康脑组织和不同病理 (如脑肿瘤)、退行性疾病 (如阿尔茨海默病、脱髓鞘病) 和创伤性脑损伤的太赫兹成像和光谱的新方法，并讨论了太赫兹技术在神经诊断领域的前景和面临的挑战。

太赫兹波对组织液的含量和状态具有很高的灵敏度，因此在脑肿瘤的术中诊断中具有非常广阔的应用前景。其他生物分子 (如脂类和蛋白质) 与组织液一同在太赫兹频率下组织介电响应的形成中起着重要作用。通过对这些生物分子进行检测，人们得以区分大脑中的正常组织和病理组织，并判断出病理过程的不同阶段。所有这些因素，连同结构神经元和神经胶质特征，包括组织特性的微观变化，使大脑成为太赫兹光谱范围内令人兴奋的研究对象。该研究团队概述了用于研究健康脑组织和不同病理 (如脑肿瘤)、退行性疾病 (阿尔茨海默病、脱髓鞘病) 和创伤性脑损伤的太赫兹成像和光谱的新方法。

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Diving with terahertz waves into the brain mysteries

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THz technologies offer novel opportunities in the intraoperative diagnosis of the brain diseases, allowing to aid or even replace labor-intensive and time-consuming intraoperative express-histology of tissues that us now commonly used during the neurosurgery to detect the pathology margins.

The research groups of Dr. Kirill Zaytsev, Prof. Degang Xu, and Prof. Valery Tuchin overviewed applications of THz technology in diagnosis of brain pathologies. Development of novel modalities for neurodiagnosis remains a challenging problem of modern applied physics, biophysics, medical and engineering sciences.

THz technology has a potential in the intraoperative diagnosis of brain tumors, thanks to the high sensitivity of THz waves to the content and state of tissue water. Along with the tissue water, other classes of biomolecules (such as lipids and proteins) play an important role in formation of the tissue dielectric response at THz frequencies. The assessment of all these biochemical compounds makes it possible to differentiate between normal and pathological tissues of the brain, as well as between different stages of a pathological process relying on the THz spectra and images. All these factors, along with the biochemical and structural neuronal and glial features, including microscopic variations of tissue properties, make the brain an exciting subject for study in the THz spectral range. The review paper by N. Chernomyrdin and co-authors describes methods and configurations of THz imaging and spectroscopy applied for studying intact (healthy) brain tissues and different pathologies, such as brain tumors (glioma, meningioma, etc.), degenerative diseases (Alzheimer's disease, demyelinating disease) and traumatic brain injuries.

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