In vitro terahertz spectroscopy of malignant brain gliomas embedded in gelatin slab

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***Abstract*—In our work, we have performed *in vitro* terahertz (THz) measurements of gelatin-embedded malignant human brain gliomas using the THz pulsed spectroscopy. The gelatin embedding yields sustain the THz response of tissues close to that of the freshly-excised ones for a long time after the resection. We have observed significant differences between the THz responses of normal and pathological tissues of the brain, which highlights a potential of the THz technology in label-free intraoperative neurodiagnosis of tumors.**

Keywords*—*terahertz technology; terahertz pulsed spectroscopy; brain tumors; glioma; intraoperative diagnosis.

I. Introduction

Recently, a remarkable progress in the area of the THz medical diagnosis has been observed – an ability for the label-free differentiation between normal and malignant tissues has been reported for various localizations [1–4]. In Refs. [5–7], a contrast between the THz response of normal tissues and malignant gliomas of the brain has been observed both in mouse/rat models, either *in vitro* and *in vivo*, or in paraffin-embedded (dehydrated) human brain tissues *in vitro*. Nevertheless, selecting the optimal frequencies and the principal components for the THz intraoperative detection of the tumor margins, as well as studying the origins of the observed contrast still remain challenging problems restraining further developments of the THz intraoperative neurodiagnosis technologies and their transfer to a clinical practice.

II. Results

In our work, using the THz pulsed spectroscopy, we have performed the *in vitro* terahertz (THz) measurements of gelatin-embedded malignant human brain gliomas and intact tissues. The gelatin embedding preserves tissues from hydration/dehydration and, thus, allows for sustaining their THz response unaltered (i.e. close to the response of the freshly-excised tissues) for a long time after the surgery [8]. The observed results (see Fig. 1) demonstrate significant differences between the normal and pathological tissues [9], including the fluorescent and non-fluorescence gliomas, when using the ALA5-induced fluorescence of protoporphyrin IX [10]. This highlights a potential of the THz technology in the label-free intraoperative neurodiagnosis of tumors.

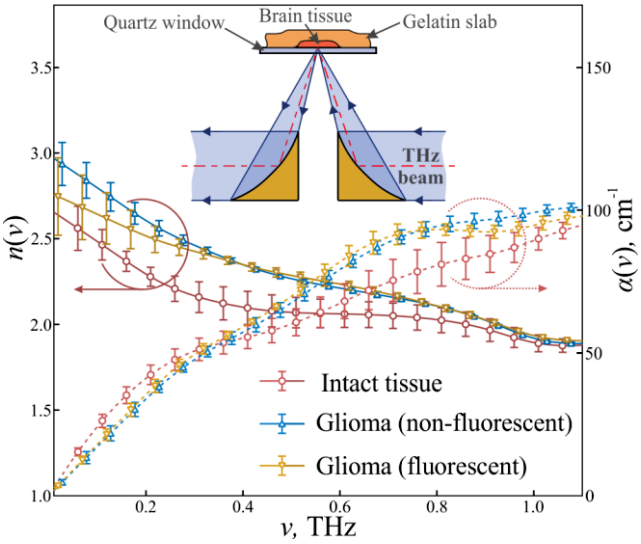

Fig. 1 THz refractive indexes n and absorption coefficients α of human brain tumors and intact tissue ex vivo, where the inset illustrates the geometry of measurements.

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