**Supplementary Material**

Reconstruction of σEPT maps

The σEPT maps were reconstructed essentially from the phase images of 3D SSFP sequence. The total phase span across the phase images was far below 2π, so no phase unwrapping was required. The 3D SSFP images are known to be comparatively insensitive to motion and B1 inhomogeneities but potentially sensitive to B0 inhomogeneities [6]; however, these inhomogeneities were negligibly small in the acquired images. Image calculations were performed at a standalone computer.

The following formula was used to convert the phase information to σEPT:

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where ε = permittivity, ω = Larmor frequency, Δ = Laplacian operator, H+ = magnetic RF transmit field, and μ=magnetic permeability of the body (≈magnetic permeability of free space).

H+ was calculated as follows:

H+ = B1 exp (iΦ+),

where B1 = RF transmit magnitude estimated a posteriori by adjusting the following constant c such that the resulting mean ε corresponded to the literature value of brain ε (i.e., B1~ sin c*r*/*r,* where *r* = distance to the voxel with minimal phase) and Φ+ = RF transmit phase estimated as half of the measured transceive phase Φ± (i.e., Φ+ ≈ Φ±/2) [6].

To remove the noise amplification inevitably introduced by the Laplacian operator, a bilateral median filter was applied to the resulting σ; i.e., the filter kernel was restricted to voxels (a) within a distance of up to 1 cm of the target voxel and (b) with a 3D SSFP signal magnitude within ±10% of the target voxel’s signal [26]. The 3D SSFP signal was taken from the same sequence as that performed to obtain the transceive phase *Φ*±.

Segmentation of each tissue component

First, the σEPT maps were coregistered to the other images, by using the default parameters of SPM12. Next, the mean signal intensity of the normal-appearing brain parenchyma was determined by averaging the signal intensities of ten regions of interest set at several regions of the normal-appearing brain parenchyma (inclusive of the cerebral cortex and white matter, basal ganglia, thalami, brainstem, and cerebellar hemispheres) on the coregistered FLAIR images (MRICron Version 1). The tumor was defined as those voxels exceeding two standard deviations above the mean signal intensity of normal-appearing brain parenchyma. The CET, NCET, and NP were then determined for each patient. CET was segmented by subtracting the precontrast-enhanced T1-weighted images from the coregistered postcontrast-enhanced T1-weighted images (Image J 1.50i) and applying the tumor area as an inclusion mask. NCET was segmented by applying the tumor and CET as inclusion and exclusion masks, respectively. NP was defined as those voxels with signal intensity lying between 25% of the mean signal intensity of the normal-appearing brain parenchyma and +1 standard deviation. To limit the inclusion of partial volume effects, the edge of each tumor area was eroded for 3 pixels (i.e., approximately 1.41 mm). A summary of the image processing steps is illustrated in Fig. 2. Each image processing step was followed by visual confirmation to ensure no gross registration or segmentation imperfections.

Segmentation of the resected tumor

Only partial resection or biopsy of the tumor was subsequently performed in most patients who underwent surgery. To obtain more reliable results, we chose to compare the σEPT value of the resected tumor area, rather than that of the whole tumor, with the σPROBE value of the tumor sample measured ex vivo. The resected tumor area was segmented by subtracting the area occupied by the CSF between the coregistered pre- and postoperative postcontrast-enhanced T1-weighted images. Postoperative postcontrast-enhanced T1-weighted images taken at the first follow-up MRI after surgery were used for this purpose. When the CSF was not properly segmented on the postoperative postcontrast-enhanced T1-weighted images due to hemorrhagic or proteinaceous products within the resected cavity or Gliadel implants, the resected tumor area was segmented manually on a coregistered anatomical image dataset which best identified the resected area (i.e., post-contrast-enhanced T1-weighted images, and/ or T2-weighted images, and/ or FLAIR images). The resected tumor area was also manually segmented if the postoperative postcontrast-enhanced T1-weighted images failed to properly coregister with the preoperative images. In such cases, drawing was done directly on the preoperative MR images, using the postoperative images as references. As in the previous segmentation, the edge of the resected tumor was eroded for 3 pixels. The resected tumor area was then superimposed onto the corresponding coregistered preoperative σEPT maps.