Ruprecht-Karls-Universität Heidelberg
Medizinische Fakultät Mannheim
Dissertations-Kurzfassung

Design and Optimization of a Cryogenic Radio Frequency Probe for Potassium-39 Magnetic Resonance Imaging at 9.4 Tesla

Autor: Ibrahim Ibrahim Ali Elabyad
Institut / Klinik: Computer Assisted Clinical Medicine
Doktorvater: Prof. Dr. L. R. Schad

Potassium-39 (^{39}K) magnetic resonance imaging (MRI) is a noninvasive technique which could potentially allow for detecting intracellular physiological variations in common human pathologies such as stroke and cancer. However, the low signal-to-noise ratio (SNR) achieved in ^{39}K-MR images hampered data acquisition with sufficiently high spatial and temporal resolution in animal models so far. Full wave electromagnetic (EM) simulations were performed for a single loop copper (Cu) radio frequency (RF) surface resonator with a diameter of 30 mm optimized for rat brain imaging at room temperature (RT) and at liquid nitrogen (LN_2) with temperature of 77 K. A novel cryogenic Cu RF surface resonator with home-built nonmagnetic G10 fiberglass LN_2 cryostat system for small animal scanner at 9.4 T was designed, built and tested in phantom and in *in vivo* MR measurements. Aerogel was used for thermal insulation in the developed LN_2 cryostat. In this work, the first *in vivo* ^{39}K-MR images at 9.4 T for both healthy and stroke-induced rats using the developed cryogenic coil at 77 K is presnted. In good agreement with EM-simulations and bench-top measurements, the developed cryogenic coil improved the SNR by a factor of 2.7 ± 0.2 compared with the same coil at RT in both phantom and *in vivo* MR imaging. Results show that the ^{39}K signal in the occluded hemisphere of the rat brain has been decreased by about 75% compared to the non-occluded hemisphere at 77 K. The significant reduction in ^{39}K signal after stroke could be considered as a relevant marker for dead tissue.