MRI Radiofrequency (RF) Coil with Efficient Excitation and Reception Neuronal Water Molecules (Ramot)

code: 8-2013-417

Gil Navon, T.A.U Tel Aviv University, Exact Sciences, School of Chemistry
Menahem Levin, T.A.U Tel Aviv University, Exact Sciences, School of Chemistry
Arnon Z"L Neufeld, T.A.U Tel Aviv University, Exact Sciences, School of Chemistry

The Technology

A simple-designed RF resonator which can be used to provide a substantially homogeneous RF magnetic field in an MRI apparatus. The homogeneity of the RF field is achieved by a judicious selection of both the electrical setup connected to conductive elements (e.g., electronic circuitry), and the geometrical characteristics (e. g., profile shape, dimensions, etc.) of conductive elements. Resonance tuning and/or the impedance matching are carried out by constructing an arrangement of transmission lines having predetermined impedance.
This invention describes an arrangement of circuitry - capacitors, tunable capacitors, inductors, tunable inductors and/or transmission lines, which have typical impedance.

The Need

The rotating magnetic field in MRI systems is provided by an RF resonator, also known as RF coil, RF probe or RF antenna. In most MRI systems, the RF resonator is used both for transmitting the RF radiation and for detecting the resulting NMR signals from the object. RF resonators are required to generate a very uniform RF magnetic field, as any inhomogeneity in the RF magnetic field causes identical spins at different locations within the imaged object to respond differently to the RF radiation thereby distorting the image or negatively affecting the quality of the analysis. Also, there is a known phenomenon that once a sample is inserted into the RF magnetic field, the resonance frequency is shifted. Thus, RF resonators are typically equipped with appropriate circuitries which tune and rematch the resonance frequencies of the RF resonator and the sample.
Here, an efficient improvement on the coils is presented with a novel design of the circuitry.

Advantages

1. In the RF resonator of the present invention, due to the small number of conductive elements, there is a decrease in the overall number of current-modes. This is preferred over the birdcage coil, where the number of legs (and the number of undesired resonance frequencies to be eliminated) is large. Also sufficient frequency spacing between the parts allows for the desired mode to be easily selected, leaving the undesired modes to be substantially inactive.
2. Minimizes energy loss between RF transmitter and RF resonator by matching their impedances.
3. Electronic circuitry has a particular feature of balancing the RF field to have a substantially symmetric profile thereby considerably reduce sample effects.

Patents

Two granted US patents: US Patent No. 7,298,145 & US Patent No. 7,573,270

Contact for more information:

Noam Greenspoon ✉,

Ramot at Tel Aviv University Ltd. P.O. Box 39296, Tel Aviv 61392 ISRAEL
Phone: +972-3-6406608
Fax: +972-3-6406675