

SAR EVALUATION FOR MEDICAL IMPLANTS

Dagang Wu¹, Ji Chen¹, David Jackson¹,
Wolfgang Kainz², Howard Bassen²

¹University of Houston

²FDA

The calculation of SAR for implanted devices exposed to electromagnetic signals is an important one for ensuring device compatibility and FCC regulation compliance. However, the accurate calculation of SAR is quite difficult when the device contains insulated wires that are embedded within the human body, and especially when such wires end in an exposed tip that is in contact with biological tissue. The pacing lead of a cardiac pacing system is a typical example.

When exposed to an external RF field (e.g., the RF signal from an MRI RF coil or gradient coil), the embedded wire acts as an antenna and consequently picks up an induced current and charge density. The induced electric and magnetic fields vary inversely with distance from the wire axis, and therefore the electric field and SAR become high at the surface of the insulation surrounding the wire. An accurate calculation of the fields and the SAR near the wire is difficult, unless a very fine mesh is used.

The problem is even worse near an exposed tip, since the insulation is removed and the conductive tip is in contact with the biological medium. Very strong electric fields typically exist near exposed conductors that have a high degree of surface curvature, such as a small tip. Hence, the local SAR will also become very large as the tip is approached. However, attempts to directly calculate the average SAR tend to produce results of questionable accuracy since the rapidly varying singular fields near the tip are typically not accounted for in the SAR calculation.

This aim of our work is to develop an accurate SAR evaluation procedure for implanted devices within a biological medium. The device will have one or more insulated wires embedded within the medium that end in an exposed tip. The tip region may have an arbitrary configuration of metal and insulation that is specified. After the SAR is calculated, further modeling will be done in order to calculate the local temperature rise throughout the medium, including regions near the wires and tip.

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1. (a)

Ji Chen

Department of Electrical and Co

4800 Calhoun Blvd.

Houston, TX

77204 U.S.A.

jchen18@uh.edu

(b) 713-743-4423

(c) 713-743-4444

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