Eddy currents heating in female 3D model with Brest Tumor

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Heat production due to eddy currents(EC) we have discussed in [1]. In this paper, we have modeled eddy current heat generation in realistic human model. Results show that eddy current heat effect is a same order as in mNP, which exhibits necessity of mechanism for eddy currents minimization. We study Eddy current and mNP Heating in realistic 3D female (Ella) 2mm resolution model at 162khz. Model is oriented to positive Z direction and faced to negative Y direction. Tumor is modeled as 1cm cube centered at (16cm,6.0cm,9.6cm), what gives to 3.0cm from skin surface to Y direction.

Wire loop is located at (16cm,-1.2cm, 9.6cm) from 2cm of nearest skin surface. We have presented Temperature and temperature rise over steady state due to mNP heating. We assume that we have 1mg mNP in 1cm 3 tumor. For 162kHz frequency this gives 85W/kg SAR at H=150Oe field (see Fig.9 in [2]). Such a small concentration we ignore density and thermal parameter changes of the tumor.

We see that EC heating effect greatly dominates to mNP heating this is due to proximity of wire loop, which gives $H \cdot f$ value is out of safety bounds ($480 - 850 M\,{}^{A}/_{(m \cdot s)}$). If we compare temperature and 10g averaged SAR distributions, we see that 10g averaged SAR correlates to temperature rise what we cannot say about point SAR distribution. We can assume, that 10g averaged SAR evaluation is necessary for proper estimation of temperature rise. E and H field calculations will not be enough for coil, or system of coils, optimization in cancer treatment for deep seating tumors.

References

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