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Ohmic heating of electrically pulsed biological cells in suspension[1]

ALLEN L. GARNER, DAVID W. JORDAN, WILKIN TANG, Y.Y. LAU, RONALD M. GILGENBACH, MICHAEL D. UHLER, University of Michigan — Intense, ultrashort pulsed electric fields have been studied for applications ranging from killing cells in suspension to reducing tumor size [1]. Recent work at the University of Michigan has focused on applying multiple ultrawideband pulsed electric fields with chemotherapeutics to obtain a synergistic effect in killing cancer cells [2]. While bulk temperature measurements indicate that these experiments have slight to no change in temperature, there remain questions about quantifying the thermal effects so that their importance compared to the electrical effects can be assessed. To estimate the thermal effects induced by applying electrical pulses of different pulse duration and intensity to cells in suspension, we apply a recent model of the Ohmic heating of spherical particulates with an arbitrary electrical conductivity exposed to an rf electric field [3]. The possible relevance of these results with regard to pulse-induced thermal effects will be discussed. [1] K. H. Schoenbach, et al. Proc. IEEE. **92**, 1122 (2004). [2] D. W. Jordan, et al. Electromed 2005, Portland, OR, pp. 89-90. [3] W. Tang, et al. J. Appl. Phys. **97**, 114915 (2005).

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