Thermal Dose Inactivation of Escherichia coli by Magnetic Induced Hyperthermia

S. Lopez, C. Trevino De Leo, I. Davila, and K. S. Martirosyan

Department of Physics and Astronomy, UTRGV, Brownsville, TX 78520

Background:

Apoptosis of mutated cells via magnetic hyperthermia has gained advocacy as technology capable of being used in lieu of chemotherapy for targeting cancer tumors. Progress of nanotechnology offers effective remote heating of magnetic fluid via hyperthermia. The heating and specific power absorption of these nanoparticles use in the magnetic fluid are dependent on particle properties and treatment locations.

Methods:

Nanoparticles were fabricated using microfluidic system by interaction of two solutions containing $2Fe(NO_3)_3$+$FeSO_4$ and NaOH+2%Dextran to create nanostructured media with a biocompatible dextran coating and a Fe_3O_4 core. The nanoparticles, of a concentration of 5mg/ml, were placed in a vile containing Luria-Bertani (LB) media with approximately $2.0x10^8$ cells. The vile was inserted into a DM100 Series Magnetic Hyperthermia Device that provides an alternating magnetic field of 300 Gauss with a frequency of 604KHz.

Results:

Magnetite produced via the microfluidic systems at flow rate of 0.04mL/s showed uniform particle size distribution with average size 10nm and saturation magnetization up to 60emu/g as well as pure-phase of Fe_3O_4 with high crystallinity. Zero-Field-Cooled and Field-Cooled measurements indicated a superparamagnetic nature of as synthesized particles with a low blocking temperature that varies by the amount of dextran introduced in the mixture.

Conclusions:

The superparamagnetic nanoparticles were heated up to 60°C, inciting a heat shock effect that led to the destruction of the *E.coli* bacteria. The specific power absorption value obtained was 130 W/g, showing that magnetite–dextran nanostructured fluid appears to be a promising active media for the local magnetic hyperthermia for cancer therapy.