

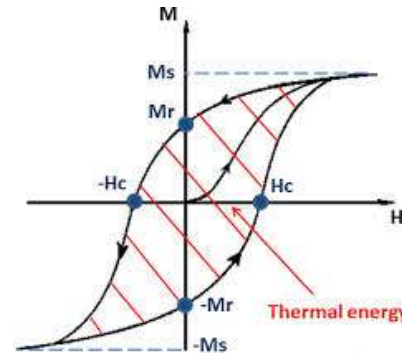
# The heat generation of magnetic nanoparticles and their bio-applications

2015-06-03  
Hyemin Song

# The heat generation of the magnetic nanoparticle

Principle of heat generating by nanoparticle

Hysteresis loss

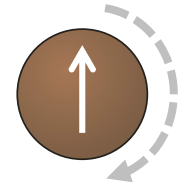
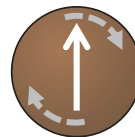


$$SLP = \int H dM$$

- Specific loss power (SLP) = watt/g
- Crystal structure, size, shape, AMF, etc.

Néel relaxation( $\tau_N$ )

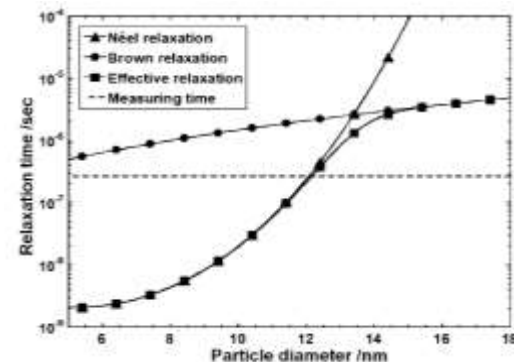
Brownian relaxation( $\tau_B$ )



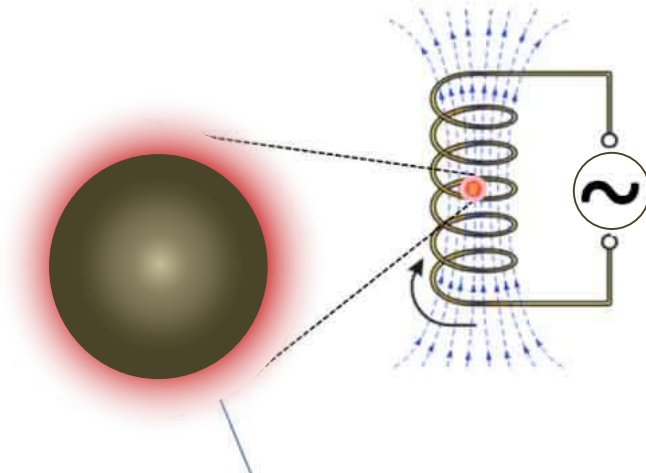
$$\tau_N = \tau_0 \exp\left(\frac{KV}{k_B T}\right)$$

$$\tau_B = \frac{3\eta V_H}{kT}$$

$$\tau = \frac{\tau_B \tau_N}{\tau_B + \tau_N}$$

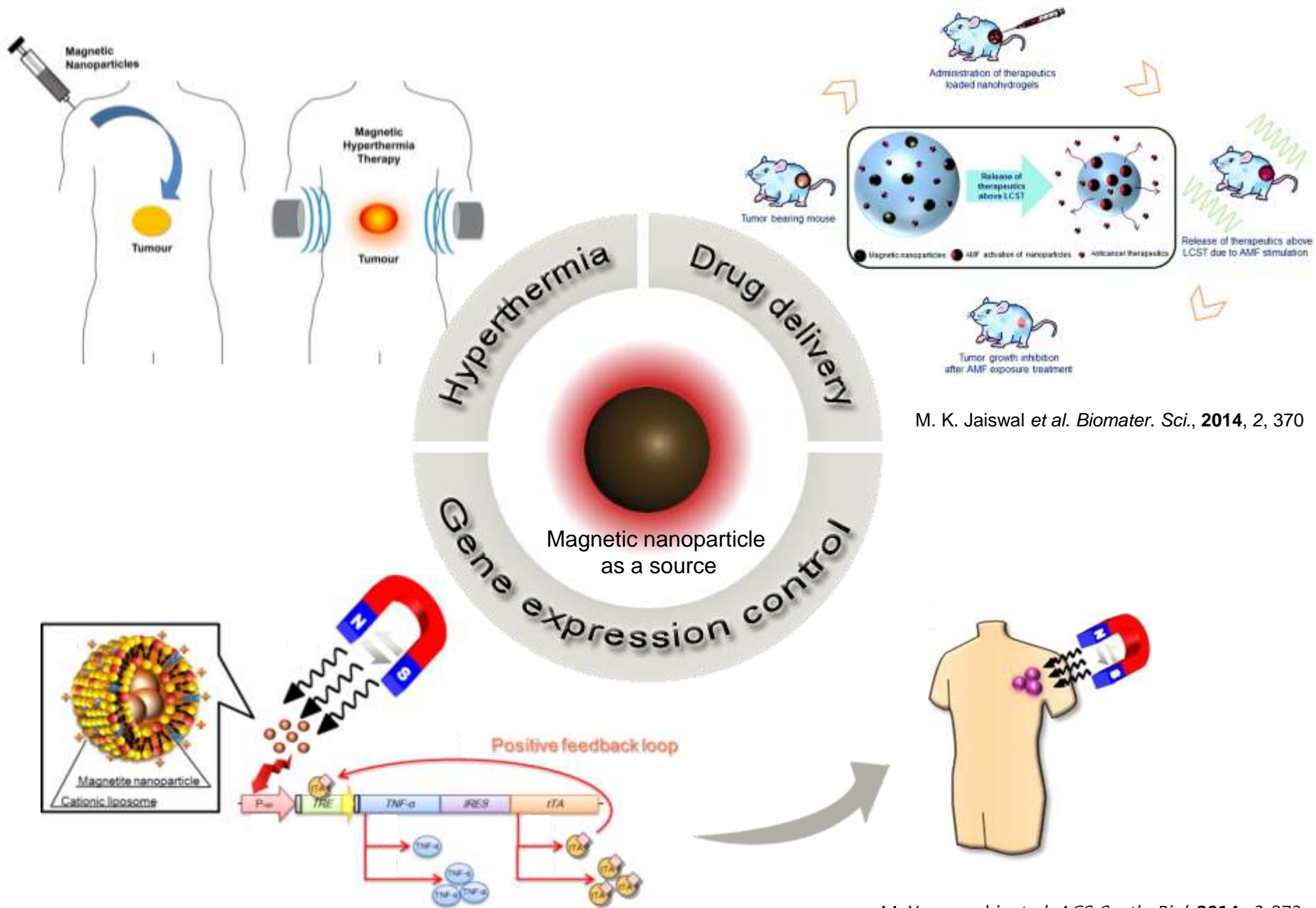


AC magnetic field



Magnetic nanoparticle as a Point heat source

# Bio-application of magnetic nanoparticle heating



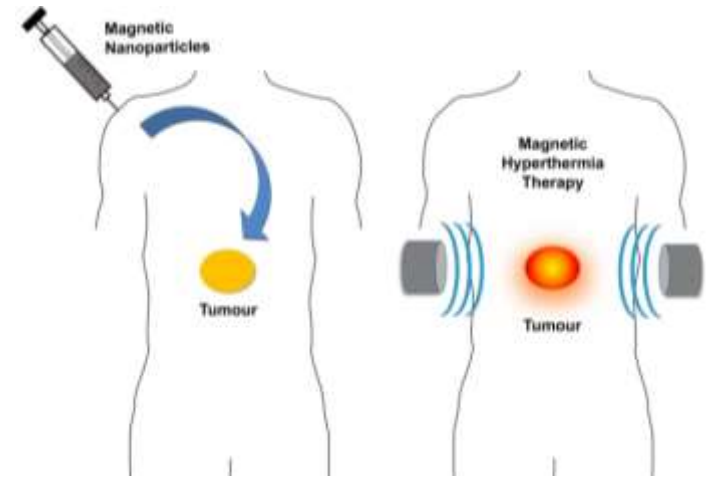
M. K. Jaiswal et al. *Biomater. Sci.*, **2014**, 2, 370

M. Yamaguchi et al. *ACS Synth. Biol.* **2014**, 3, 273

# ***Hyperthermia of magnetic nanoparticle***

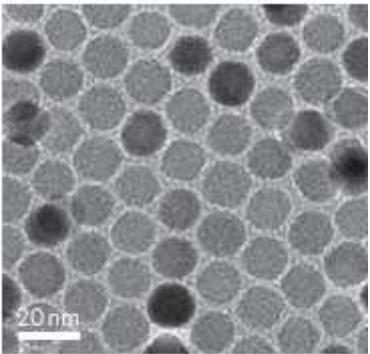
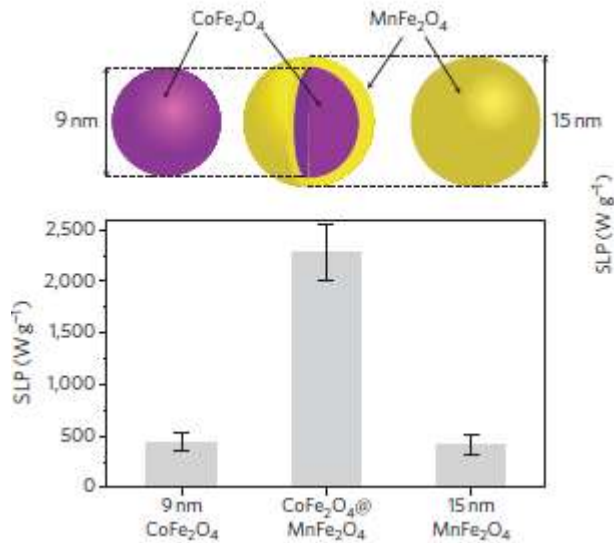
## *What is the hyperthermia?*

Hyperthermia is a type of cancer treatment in which body tissue is exposed to high temperatures (up to 42°F). Research has shown that high temperatures can damage and kill cancer cells



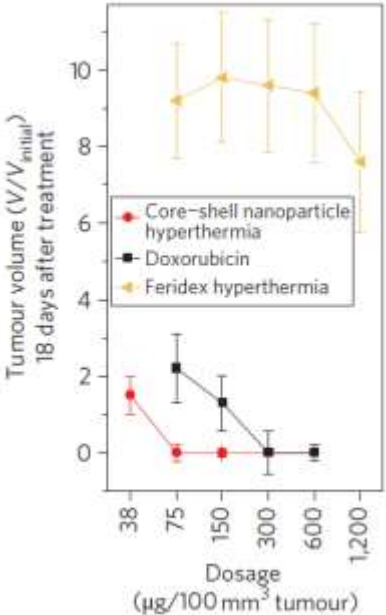
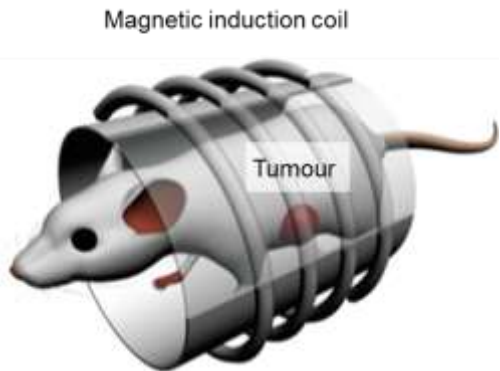
# Hyperthermia of magnetic nanoparticle

## Magnetic nanoparticles



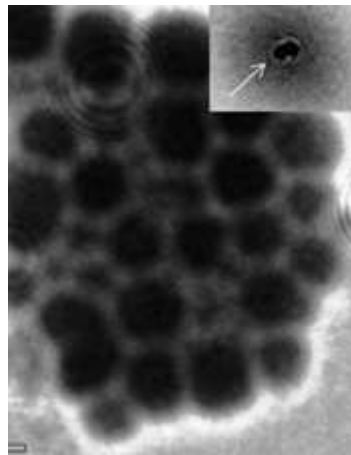
Magnetic nanoparticle was made up magnetically hard core and magnetically soft shell to tune the magnetically properties.

## Apply for hyperthermia



# Drug delivery system of magnetic nanoparticle heating

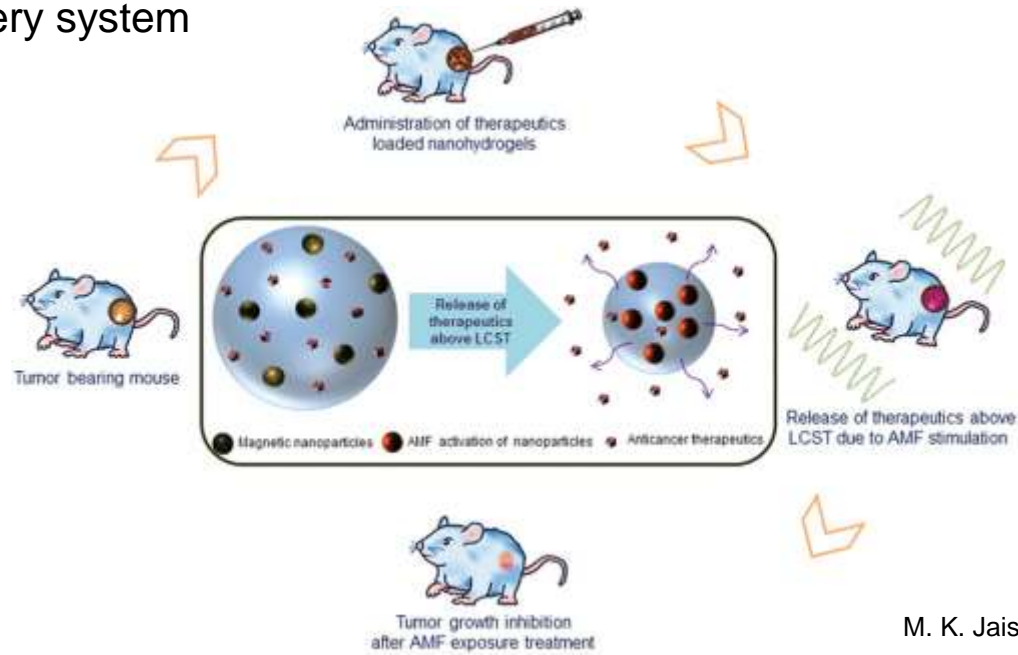
## Magnetic nanoparticles



## Magnetic nanohydrogel (MNHG)

: Poly(N-isopropylacrylamide)-chitosan based magnetic nanohydrogel incorporated with  $\text{Fe}_3\text{O}_4$  nanoparticles

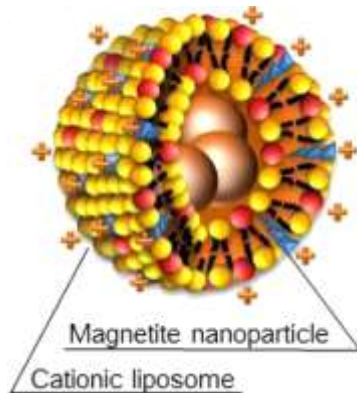
## Apply for drug delivery system





# Gene expression system of magnetic nanoparticle heating

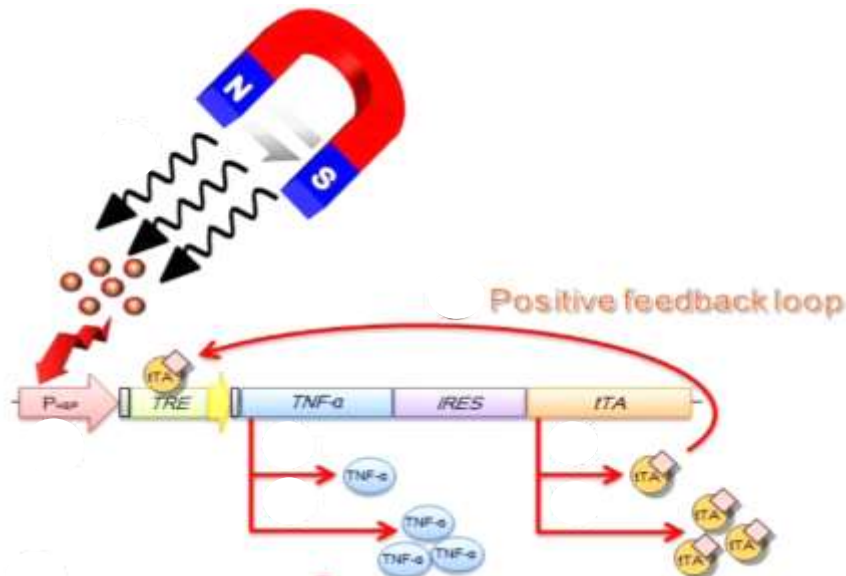
Magnetic nanoparticles



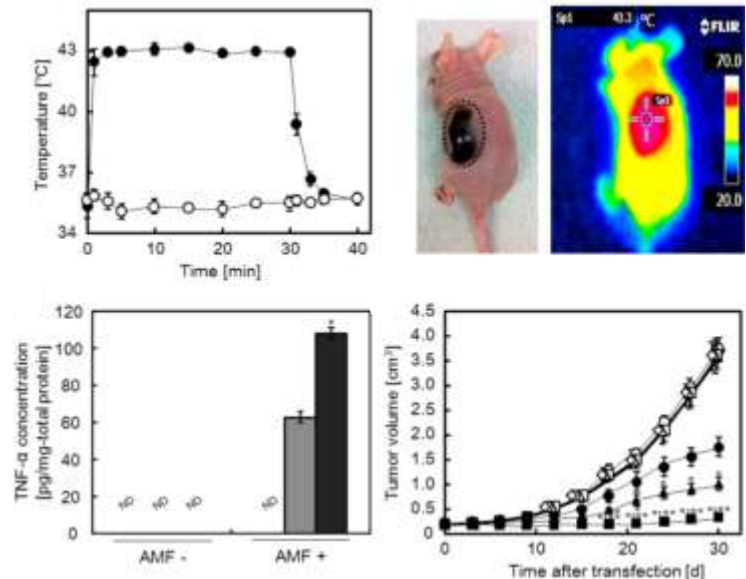
Magnetite cationic liposomes (MCLs)

: Encapsulating 10 nm magnetite particles in cationic liposome.

Apply for gene expression control



Evaluate the in vivo therapeutic effects



## ***Conclusion***

The heat generation of magnetic nanoparticles has the potential to be a powerful, noninvasive technique for biotechnology applications such as drug release, cancer therapy and others.



***Thank you***