











is competing coupling between gold nanoparticles and RNA polymerase to DNA strands. As the gold nanoparticles are around the copying site, there will be PPB effects due to coupling between DNA and positively charged nanoparticles.

- As for the MPB (Multiplication Process Block) effects without physical fields, there are two kinds of blocking effects. The first effect appears during duplications of DNA. In the process, positively charged gold nanoparticles will block DNA polymerase and DNA helicase activity by sticking to DNA strand. Secondly MPB effect happens from prophase to metaphase of cell division cycle by disturbing alignment of chromosomes at metaphase plate.
- PPB and MPB effects will be enhanced by applying physical fields such as electromagnetic waves, X-rays or ultrasound.

In order to deepen and develop the theoretical considerations in this paper, further studies are needed as for the following points.

- Experiments of introducing surface functionalized gold nanoparticles into living cells.
- Comparison of the effectiveness of cancer treatments depending on the three types in Figure 2.

## REFERENCES

- [1] Takeishi S, Matsumoto A, Onoyama I, Naka K, Hirao A, Nakayama KI. Ablation of Fbxw7 eliminates leukemia-initiating cells by preventing quiescence. *Cancer Cell* 2013; 23: 347-61. <http://dx.doi.org/10.1016/j.ccr.2013.01.026>
- [2] Shenoy D, Fu W, Li J, *et al.* Surface functionalization of gold nanoparticles using hetero-bifunctional poly(ethylene glycol)spacer for intracellular tracking and delivery. *Int J Nanomedicine* 2006; 1: 51-7. <http://dx.doi.org/10.2147/nano.2006.1.1.51>
- [3] Bruce A, *et al.* *Molecular biology of the cell*, 4<sup>th</sup> ed. Gerland Science. New York, USA 2002; p. 621.
- [4] Maeda H. Tumor-selective delivery of macromolecular drugs via EPR effect: Background and future prospects. *Bioconjug Chem* 2010; 21: 797-802. <http://dx.doi.org/10.1021/bc100070g>
- [5] Bruce A, *et al.* *Molecular biology of the cell*, 4<sup>th</sup> ed. Gerland Science. New York, USA 2002; p. 672.
- [6] Bruce A, *et al.* *Molecular biology of the cell*, 4<sup>th</sup> ed. Gerland Science, New York, USA 2002; p. 199.
- [7] Naruse Y. Theoretical analysis on the possible interruption of cell division by applying physical excitation to gold nanoparticles introduced in chromosomes. *J Memb Sepa Technol* 2012; 2: 120-24.
- [8] Williams R. Becquerel photovoltaic effect in binary compounds. *J Chem Phys* 1960; 32: 1505-14. <http://dx.doi.org/10.1063/1.1730950>
- [9] Naruse Y. Mechanical vibration model for chromosomes in metaphase of mitosis and possible application to the interruption of cell division. *Biosystems* 2002; 66: 55-63. [http://dx.doi.org/10.1016/S0303-2647\(02\)00033-3](http://dx.doi.org/10.1016/S0303-2647(02)00033-3)

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