Introduction of Gold Ion Solution into Living Cells: Uptake Mechanism and Applications

Paul Thompson (paul.thompson@rice.edu), Shintaro Fujii, Nicholas Smith, Katsumasa Fujita, Satoshi Kawata

Laboratory for Scientific Instrumentation and Engineering, Kawata Laboratory, Osaka University, Suita Campus

Introduction

• A better understanding of the relationship between living cells and nanotechnology is essential for successful clinical applications.
• By closely monitoring the response of a cell colony after the introduction and uptake of a gold ion solution, it may be possible to determine and predict the ideal conditions for a wide array of scientific techniques.
• Improvement in assorted imaging systems such as Raman spectroscopy
• Potent cancer treatment therapies.
• Advanced exploration of cellular biology.

Methods

• HeLa (human cervical cancer) cells were cultured in glass-bottom dishes using Dulbecco/Vogt Modified Eagle’s Minimum Essential Medium (DMEM) for cellular nutrition, then incubated at 37 degrees Celsius and 5 percent CO₂ for approximately 48 hours.
• When dishes were 30-40 percent confluent (covered with cells), DMEM was exchanged with experimental media and gold (III) chloride (HAuCl₄) was added.
• Media was either Phosphate Buffered Saline (PBS) with glucose, PBS without glucose, or DMEM without pH indicator (colorless).

Results

• In cases involving PBS with and without glucose, cells incubated with HAuCl₄ survived longer (approx. 24 hours) than controls.
• Although time lapse photography could not confirm the movement of HAuCl₄ into the cells, preliminary Raman spectra results suggest that gold ion solution was internalized by the cells incubated with 1 mM HAuCl₄ in PBS without glucose.

Further Research and Applications

• The Laboratory for Scientific Instrumentation and Engineering plans to continue research on the effect that gold ion solution has on cellular viability.
• An expanded version of the trial will be conducted to facilitate easier and more accurate comparisons between experimental sets and controls.
• In addition, a wider variety of cell media and HAuCl₄ concentrations will be used to glean more information about the mechanisms behind experimental results.
• Transmission electron microscopy will be used to obtain additional images of gold particles within cells.
• Research may eventually result in an effective form of intracellular targeted photodynamic therapy.

Acknowledgements

• The NanoJapan Program is generously funded by the National Science Foundation. Many thanks to LaSIE at Osaka University’s Suita Campus for allowing me to conduct research with their group and Rice University for giving me this opportunity.

Questions

• Can living cells survive in gold ion solution, and, if so, what is the best combination of gold ion concentration and cellular medium for survival?
• Can gold ions be reduced inside the cell and form gold nanoparticles?

References