# ANTIBACTERIAL ACTIVITY STUDY OF COPPER OXIDE NANOFLUIDS FOR INFECTION CONTROL IN HOSPITAL ENVIRONMENT

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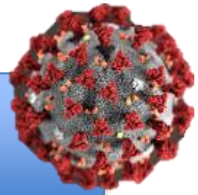
# Introduction



Coronavirus disease appears.

Due to its antibacterial potential, copper and its alloys have attracted the attention of the scientific community.

The use of nanoscale materials with antimicrobial properties is another approach that has been considered.

# Copper Oxide nanofluids - Applications

- Chemical detection devices
- Disinfection
- Antimicrobial reagents
- Anti-fouling
- Antioxidants
- Cosmetics

# Copper Oxide nanofluids - Properties

- Crystal structures and phase transition
- Electronic band structure
- **Electrical conductivity**
- Optical properties
- Photoelectrochemical (PEC) properties
- Magnetic properties
- **Antibacterial property**

# Copper Oxide nanofluids – Antibacterial property

The reactive oxygen species produced by the CuO nanoparticles penetrate the cell by interacting with the cell membranes, consequently leading to the disruption of the cellular enzyme.

Due to this antibacterial potential, nanoparticles are used as a coating material on various objects, such as food packaging.

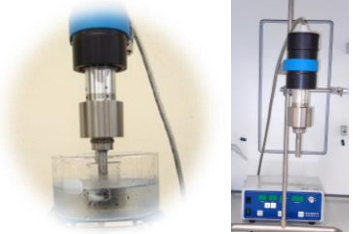
# Copper Oxide Nanofluid - Preparation

Nanoparticle

Base fluid

Mixing (magnetic stirring)

Ultrasonication



Thermostatic bath

Electrical conductivity measurement

Antibacterial study

Figure 1 – Copper Oxide nanofluid preparation scheme.

# Copper Oxide Nanofluid - Centrifuged Sample

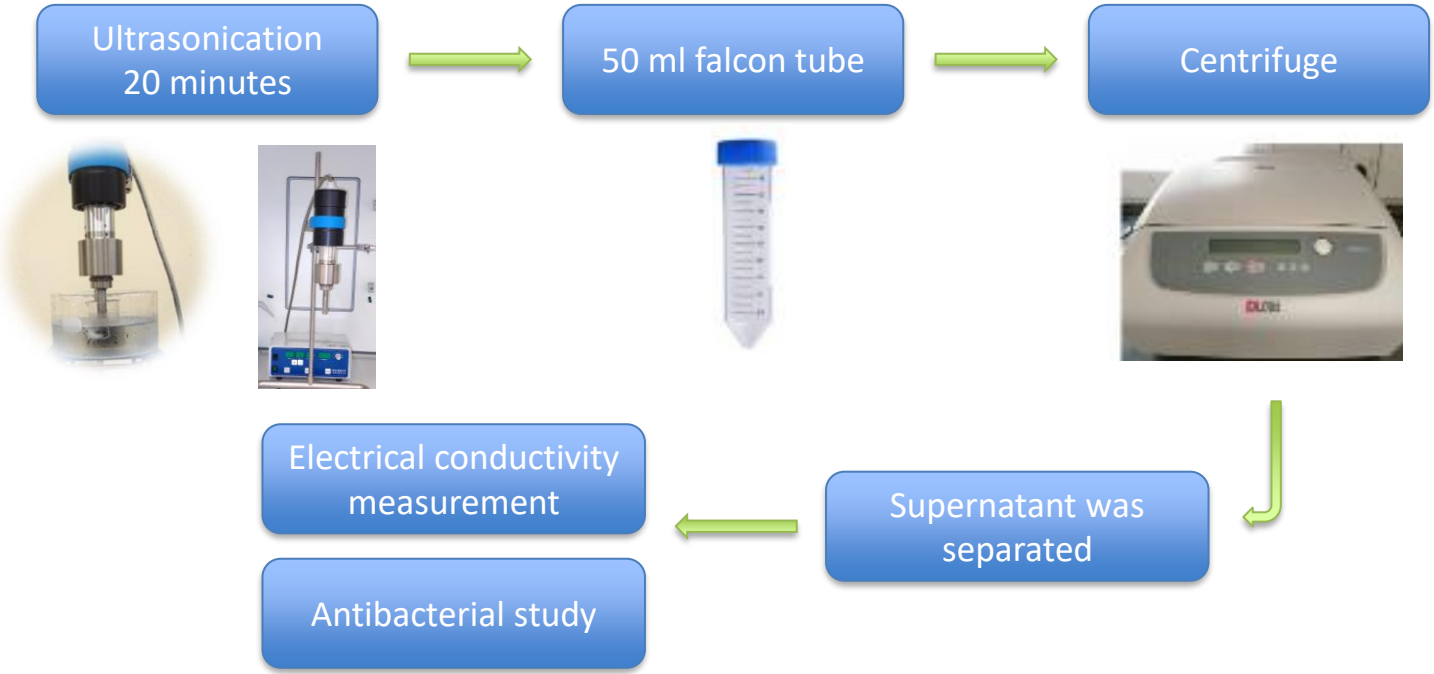
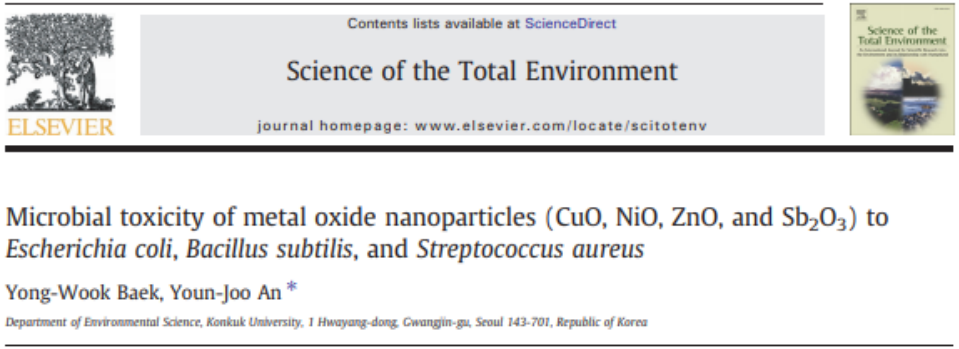



Figure 2 – Copper Oxide nanofluid centrifuged sample scheme.

# Copper Oxide Nanofluid – Antibacterial Study Procedure



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Microbial toxicity of metal oxide nanoparticles (CuO, NiO, ZnO, and $Sb_2O_3$) to *Escherichia coli*, *Bacillus subtilis*, and *Streptococcus aureus*

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Figure 3 – Research procedure carried out by Yong-Wook Baek.

Bacterial strains tested:

- *Staphylococcus aureus*
- *Escherichia coli*

Cupper Oxide nanofluids samples studied:

- 5% V centrifuged
- 5% V
- 7% V

# Copper Oxide nanofluid - Results

Table 1 – Microbiological testing.

| | | Microbiological Testing | | | |
|---|---|---|---|---|---|
| | | Control (2 replicas) | Experience 1 (2 replicas) | Experience 2 (2 replicas) | Experience 3 (2 replicas) |
| **Culture medium** | | 20 ml | 20 ml | 20 ml | 20 ml |
| **CuO Nanofluid** | Φ (%V) | - | 0.56 | 0.56 | 0.77 |
| | Added volume | | 2.5 ml | 2.5 ml | 2.5 ml |
| | Sample centrifugation | | Yes | No | No |

# Copper Oxide nanofluid - Results

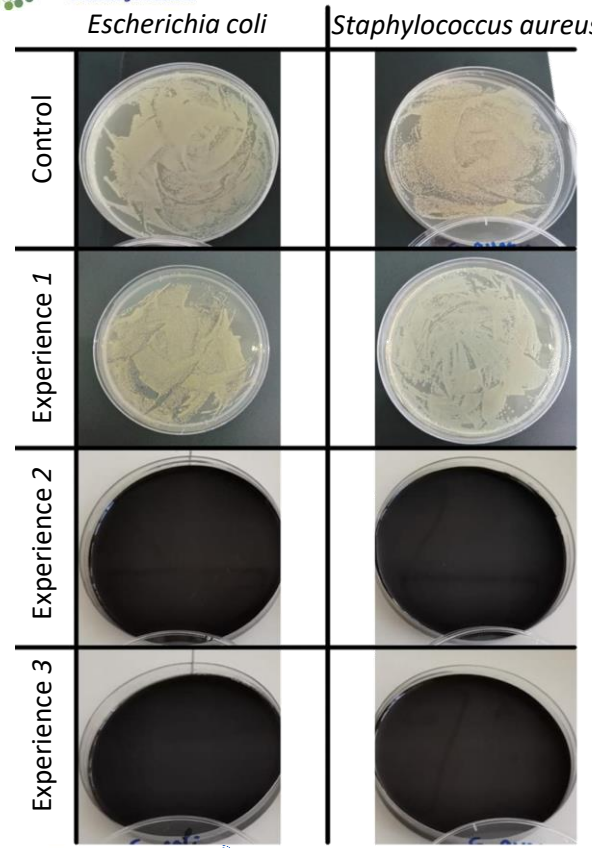


Figure 4 – Bacteriological study.

Bacteria proliferated normally in the presence of a supernatant CuO sample.

The Petri dishes relating to experiments 2 and 3, which contained CuO nanofluids with a volume percentage of 5% and 7%, do not show any bacteria.

The antibacterial power of CuO nanoparticles has been proven.

# Copper Oxide nanofluid - Conclusions

- Bacteria (*S. aureus e E. coli*) proliferate in the control sample and supernatant sample.
- In this study was possible to confirm the antibacterial properties of CuO nanoparticles.
- For the concentrated samples of CuO 40 nm, 5% and 7%, no bacteria growth was verified, reaffirming that copper oxide, in high concentrations, can generate a wide range of substances harmful to the bacterial cell.

# Thanks for your attention