

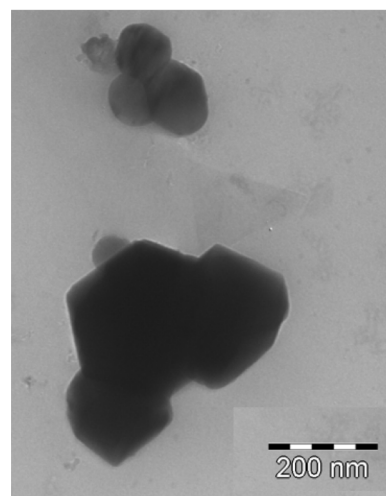
## Investigating the antimicrobial properties of copper-infused fabrics

“Without the BBSRC Metals in Biology grant we would have found it much more difficult to collaborate with the University of Southampton on investigations into anti-microbial copper nanoparticles.” Copper Clothing Limited



Bill Keevil & Susanna Sherwin, University of Southampton;  
Rory Donnelly, Copper Clothing Ltd

Of the fabric samples tested with three different bacteria, the thin, single-layered bamboo viscose and nylon fabrics impregnated with copper showed a greater than 99.9% reduction of bacteria at 24h. In contrast, the more absorbent and thicker tea towel fabrics impregnated with silver or copper showed no reduction of bacteria after 24h. It is suggested that the main difference between the two types of fabrics were the thickness and absorbency. To investigate a sustainable way of producing copper nanoparticles, the bacterium *Morganella psychrotolerans* was trained to grow on  $\text{CuSO}_4$  agar. The industrial partner was able to select for variants that could survive in the presence of this usually bactericidal chemical. When  $\text{CuSO}_4$  was added to the growth media, the bacterial pellet took on a brown colour, suggesting that copper nanoparticles were present inside the bacteria. Although we were unable to visualise these, we managed to image nanoparticles of various sizes present in the supernatant of the growth media, the largest of which are well defined hexagonal nanoparticles (Figure).



Nanoparticles of copper present in the supernatant of *Morganella psychrotolerans* after overnight growth in  $\text{CuSO}_4$ . Hexagonal particles layered together to form a multi-sided aggregate.

**INITIAL AIMS:** Copper ions can not only kill bacteria, but also destroy DNA, reducing the potential for horizontal transfer of resistance genes. The Industrial partner is currently using industrially made copper for the manufacture of antimicrobial fabrics, and is investigating renewable processes for incorporating copper into their fabrics. In order to determine the efficacy of producing and using nanoparticle copper as part of antimicrobial fabric manufacture, it is necessary to set a base-line of the levels of the antimicrobial capability of industrially sourced copper in copper clothing. The academic partner will evaluate fabrics using culture and advanced microscopy methods to determine their antimicrobial properties. They will also work to harness *Morganella spp* bacteria that are able to extract copper from their environment and contain it as nanoparticle-copper within their cells.

- Thin, single-layered fabrics impregnated with copper showed a greater than 99.9% reduction in bacteria
- *Morganella spp* can extract copper from the environment and contain it as nanoparticle copper
- Copper Clothing Ltd used follow-on funding to show that copper impregnated wound dressings can reduce time for wounds to heal by 80% and is seeking approval to go to market