Viruses & Antimicrobial Control

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Viruses are the most common biological entities on Earth. Experts estimate there are around 10,000,000,000,000,000,000,000,000,000,000 of them. Viruses rely on the cells of other organisms to survive and reproduce, because they cannot capture or store energy themselves.

At the core of a virus particle is the genome, the long molecule made of DNA or RNA that contains the genetic instructions for reproducing the virus. This is wrapped up in a coat made of protein molecules called a capsid, which protects the genetic material.
Some viruses also have an outer envelope made of lipids, which are fatty organic molecules. The coronavirus that causes COVID-19 is one of these “enveloped” viruses. Soap can dissolve this fatty envelope, leading to the destruction of the whole virus particle. That’s one reason washing your hands with soap is so effective!

Viruses that do not recognise our cells will be harmless, and some others will infect us but will have no consequences for our health.
Many animal and plant species have their own viruses. Cats have the feline immunodeficiency virus or FIV, a cat version of HIV, which causes AIDS in humans. Bats host many different kinds of coronavirus, one of which is believed to be the source of the novel coronavirus that causes COVID-19.
Viruses can mutate and combine with one another. Sometimes, as in the case of COVID-19, they can switch species.

The most important ones to humans are the ones that infect us. Some families of viruses, such as herpes viruses, can stay dormant in the body for long periods of time without causing negative effects.
Once a person is infected with a virus, their body becomes a reservoir of virus particles which can be released in bodily fluids such as by coughing and sneezing or by shedding skin or in some cases even touching surfaces. The virus particles may then either end up on a new potential host or an inanimate object. These contaminated objects are known as fomites, and can play an important role in the spread of disease.

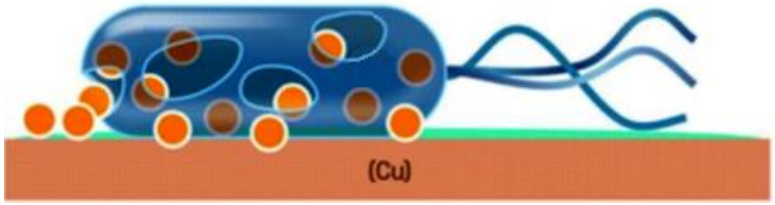
Coronavirus, like SARS (Severe Acute Respiratory Syndrome) and MERS (Middle East Respiratory Syndrome), are those pathogenic organisms, more influential to animals than humans, which sometimes form mutant strains potentially fatal to human life.

Different viruses seem to have differing abilities to survive outside the body, however, and we are still learning about the new. One study suggests that the coronavirus can survive for up to 72 hours on plastic and stainless steel, less than 24 hours on cardboard and less than 4 hours on copper
However, a report by the US Centres for Disease Control and Prevention suggested that traces of the new coronavirus could be present on surfaces for longer. This is because RNA from the virus was detected on surfaces in the cabins of the Diamond Princess cruise ship 17 days after passengers had left, including those who hadn’t shown symptoms of covid-19.
Other research suggests that the related SARS and MERS coronaviruses can persist on metal, glass and plastic surfaces for up to nine days. (newscientist.com/viral-survival)

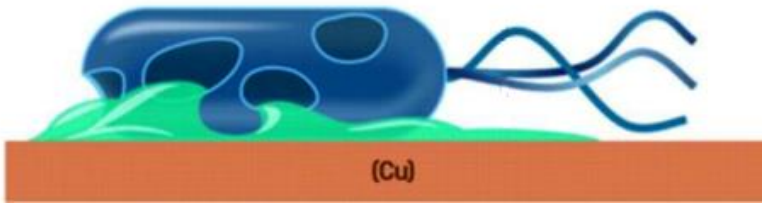
To fight a virus requires vaccines and medicines and these can be extremely costly in terms of time and money, both directly in finding a solution and indirectly with the disruption in business and trade worldwide. Even then any possible solution has to undergo vigorous clinical testing before being made available to the general public.

A way ahead is to use one of nature's natural virus killers, Copper (Cu). Copper can help control the spread of a virus left on inanimate objects such as doors, work surfaces, press buttons, levers and touch screens. The killing of bacteria by copper, so-called "contact killing," is now well established and has explicitly been shown for many species. Bacteria are killed within minutes on surfaces of copper or copper alloys containing at least 60% copper.

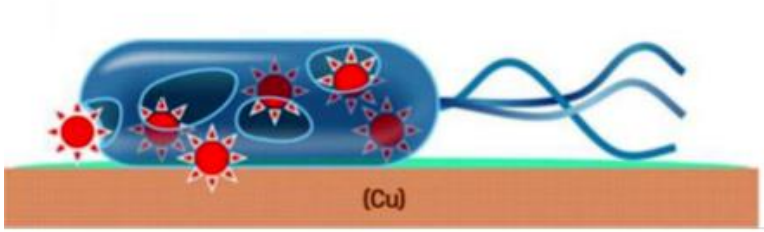
Antimicrobial activity of Copper



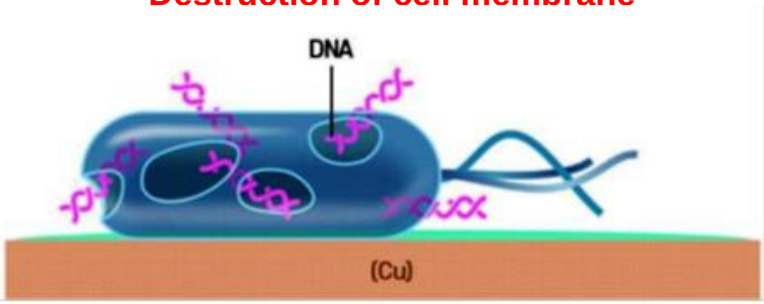
Copper dissolves from the copper surface and causes cell damage.
Copper ions infiltrate through the bacteria cell



The cell membrane ruptures because of copper and other stress phenomena, leading to loss of membrane potential and cytoplasmic content
Destruction of cell membrane

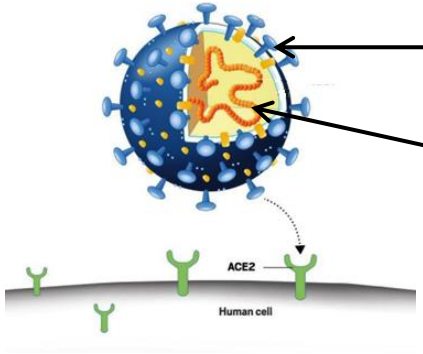


Copper ions induce the generation of reactive oxygen species, which cause further cell damage.
Acceleration of cell destruction



Genomic and plasmid DNA becomes degraded..
Genome and plasmid DNA decomposition
Suspension of Cell replication and self-replication

Human infection mechanism of virus



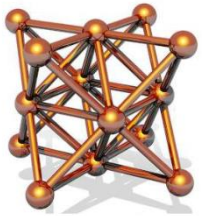
Glycoprotein Spike" is the key to penetrate and invade the human cell.

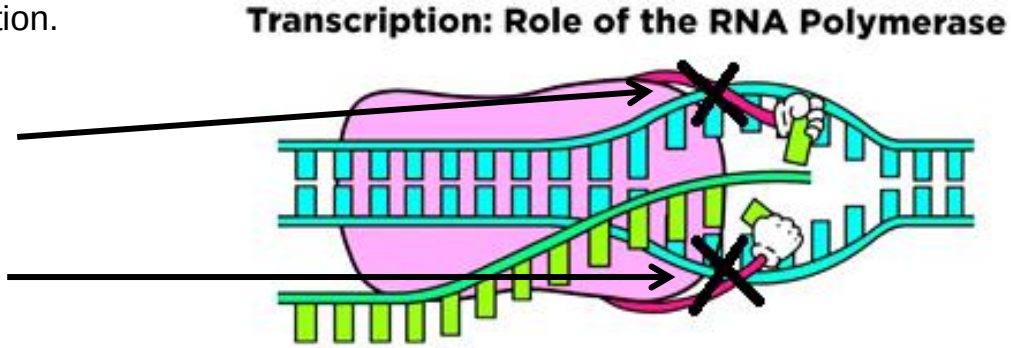
RNA acting as the core material for replication of virus.

RNA polymerase facilitates the RNA replication as the catalyst.

Principle of Antiviral effect of Copper

Antimicrobial Cu acts as an inhibitor of virus RNA replication.



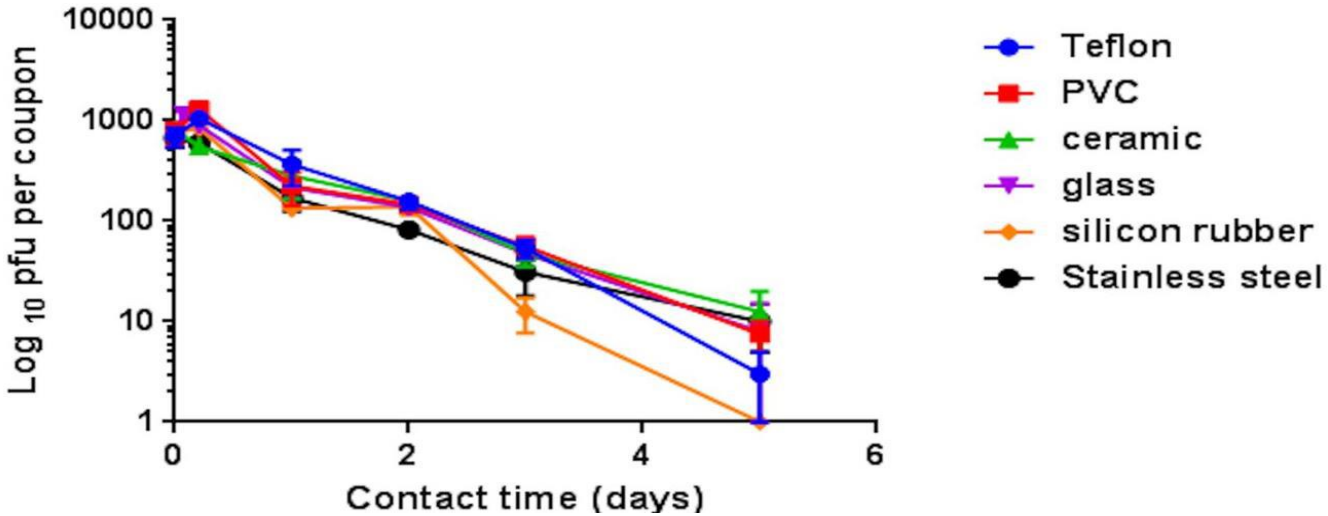


Hand-infected germs (bacteria) can form a great environment for virus to self-replicate
Antimicrobial copper inhibits the replication of germs preventing the viruses from self-replicating .

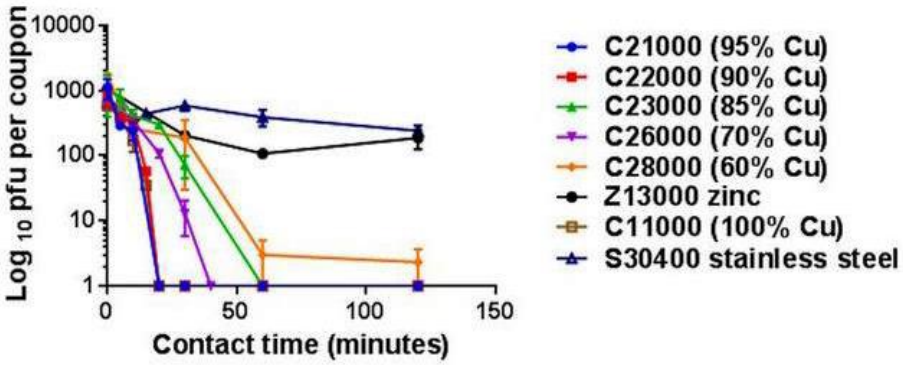
RNA polymerase, abbreviated RNAP, is an enzyme that synthesizes RNA from a DNA template. RNAP locally opens the double-stranded DNA so that one strand of the exposed nucleotides can be used as a template for the synthesis of RNA, a process called transcription

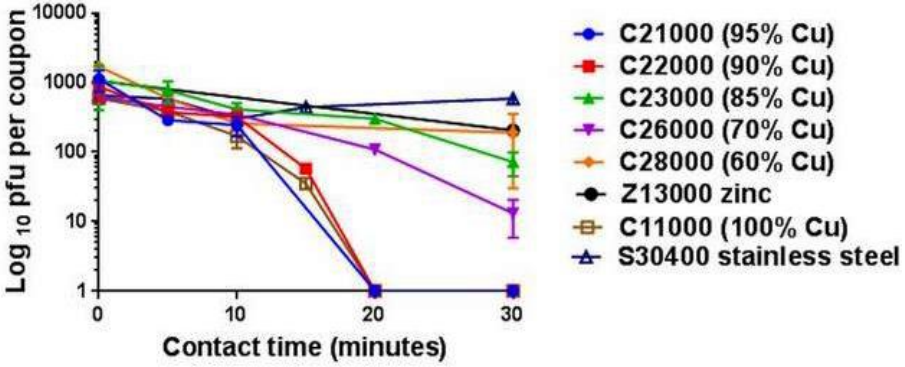
Antimicrobial activity of Copper

Graph showing time against decay of Coronavirus on various materials.



Graph showing time against decay of Coronavirus on coppers of various purity





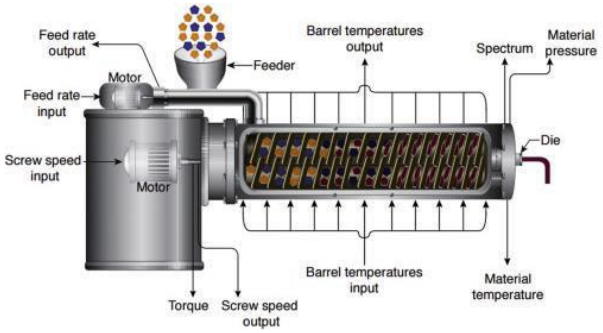
Antimicrobial film Cu+

The Antimicrobial material consists of a Polyethylene terephthalate (PET) film 11 microns thick. The film has 3 types of copper powder, spherical, dendritic and flake formations distributed throughout the material. The copper powder and polymer pass through an Archimedes screw mixer to ensure the copper particles are uniformly dispersed and have not united thus maintaining a constant antimicrobial effect of the finished sheet.
PET is the most widely produced plastic in the world. It is used predominantly as a fibre (known by the trade name “polyester”) and for bottling or packaging. For example, PET is the plastic used for bottled water and is highly recyclable.

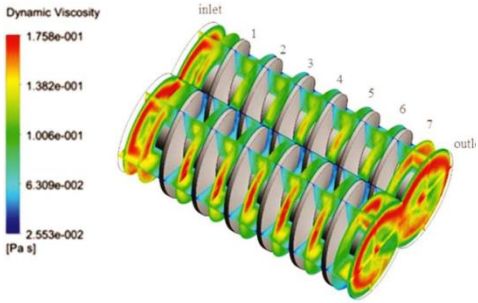
Adhesive Backed Antimicrobial Film Cu+

This material is the same as above but has a strong adhesive coating and silicon coated backing paper enabling the film to be stuck directly to a surface.
Both products are supplied on a roll, 400mm wide x 20 metre in length or on reels 25 and 50 mm wide.
The products carry the Cu+ logo.
The International Copper Alliance (ICA) is international non-profit alliance with a history going back 60 years. It was established in 1960 for promoting technologic invention in the copper market.

To recognise the superiority of antimicrobial copper to customers, they attached the Cu+ mark as a certification mark to copper/copper alloys containing more than 60% of copper that have an antimicrobial effect as an internationally recognised acknowledgement.
Cu+ mark branded copper-related product is acknowledged for their antimicrobial effect that can be utilized without apprehension.



Antimicrobial mixing machine where 3 forms of copper and the polymer are combined.



Archimedes screw mixer ensuring the copper particles are uniformly dispersed.