

# TECHNICAL INNOVATION

技術情報 Chemical Technology



## 銅が新型コロナに効くという文献のご紹介

当社の光触媒コーティングは他の光触媒に見られない強い殺菌・抗ウイルス機能を有していることをご紹介してきましたが、その作用原理としては「金属銅微粒子から発生する銅イオン  $\text{Cu}^{2+}$  に依存し、光触媒はその反応を促進させるための黒子の役割」とご説明してきました。銅の強力な感染予防効果は 19 世紀のヨーロッパですでに注目されていて、当時猖獗を極めていたコレラの感染者が銅製錬所の作業員に限って 1 人も発生しなかった事実がきっかけでした。

新型コロナ禍でこの銅（と銅から発生する銅イオン  $\text{Cu}^{2+}$ ）の殺菌・抗ウイルス機能とりわけ新型コロナ Covid-19 への抗ウイルス機能が脚光を浴びていて今、世界中でこれに関する論文が輩出されています。

**Advisory Board**

**Can copper protect against the new coronavirus? Here's what the evidence says.**

June 25, 2020

Over the past few months, there has been a surge in the market for materials laced with copper—including face masks, bed sheets, and socks—with manufacturers touting the metal's germ-killing ability. But experts say consumers should be cautious, as copper isn't a cure-all against the new coronavirus.

**Just how effective are masks at stopping coronavirus? Here's what new research says.**

**How copper kills germs**

Copper is known for killing microbes and has been shown to help limit the spread of *E. coli*, salmonella, and influenza.

According to Karrera Djoko, a biochemist and microbiologist at Durham University, when copper comes into contact with a germ, it has the ability to release reactive ions that puncture the exterior of the germ. The ions can then access the inside of the germ, affecting its genetic material.

Copper can also affect microbes in other ways. For instance, according to Michael Johnson, a microbiologist at the University of Arizona, metal ions are found in around 40% of proteins with known structures—and when copper works its way into a cell or a virus, it can displace other metal ions, which can inhibit or destroy proteins. "If 40% of your proteins don't work, you don't work," Johnson said.

The human immune system also utilizes copper to fight germs. Research suggests that certain immune cells, called macrophages, may be able to envelop and separate germs in an acidic "ball of death" chamber, which is then spiked with copper doses fatal to the germ, Johnson said.

**PERSPECTIVE**

**CAN COPPER HELP FIGHT COVID-19?**

Experts on copper and microbiology recommend the expanded use of copper alloys in public spaces to reduce the spread of COVID-19 and minimize future pandemics.

Harold T. Michels, consultant and retired senior vice president, Copper Development Association, Manhattan, New York


Corinne A. Michels, distinguished professor emerita, Queens College — CUNY, Flushing, New York

Copper can be a powerful weapon in the fight against COVID-19 and future pandemics, but we have to use it. Throughout history, copper was recognized for its antimicrobial activity, with the advent of antibiotics, the value of copper as a medical treatment was pushed aside and lost from our collective knowledge base. While the world focuses on treating those with COVID-19 and developing testing kits and vaccines, prevention will soon take greater prominence. An ever-increasing body of research indicates that copper alloys have the potential to control the spread of infectious disease and blunt the impact of future pandemics. "No sense of prevention is better than a pound of cure."

**INACTIVATION STUDIES**

A recent, highly publicized New England Journal of Medicine article

broad spectrum of lung disorders. An article published in 2012, authored by Williams et al., showed that H1N1-COV-2009 remained infectious following exposure to polytetrafluoroethylene (PTFE or Teflon), polyvinyl chloride (PVC), ceramic tile, glass, silicone rubber, and stainless steel, but was rapidly inactivated on copper and on a range of copper alloys and copper-nickel alloys. Complete loss of infectious activity was reached after as little as a five-minute exposure, depending on the particular alloy tested. Not only was the inactivation rapid but it was accompanied by the irreversible destruction of viral RNA and massive structural damage.



**Could copper ions kill COVID-19 on surfaces long-term?**


May 5, 2020 By Nancy Crotti

Researchers in Israel are developing long-lasting, antiviral coatings for high-touch surfaces as door knobs to reduce the spread of COVID-19.

These novel coatings contain nanoparticles of safe metal ions and polymers with anti-viral and anti-microbial activity, according to the researchers at Ben-Gurion University (Beer Sheva) and the National Institute of Biotechnology in the Negev.

Even in small quantities, certain metals can be lethal to viruses and bacteria but are not poisonous to humans. In proof-of-concept experiments, the researchers assessed the effect of surfaces coated with nanoparticles of various metals on the infectivity of lentiviruses, which belong to the HIV family in human cells. Findings show that surfaces coated with copper nanoparticles strongly block infection of the cells by the virus. These ongoing experiments show potential for copper ions in preventing surface-mediated infection with SARS-CoV-2, according to the scientists.

Based on these findings, the researchers are developing anti-viral coatings that can be painted or sprayed on surfaces. The polymer-based coatings contain nanoparticles of copper and other metals, which will enable controlled release of metal ions onto the coated



Ph.D. student Eyal Toledo and postdoctoral candidate Guillaume Le Saux at Dr. Mark Schwartzman's laboratory at Ben-Gurion University (Photo by Dani Machlis)

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**9 patients?**

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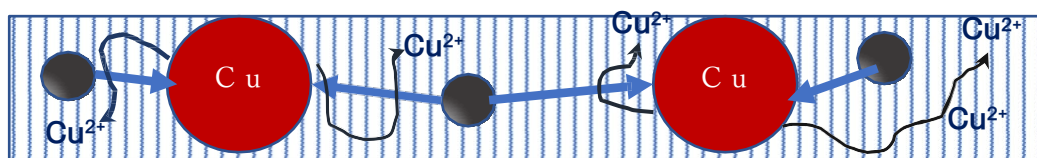
**A C T**

Cu is an essential micronutrient for both pathogens and the hosts during viral infection. Cu is involved in the function of critical immune cells such as T helper cells, B cells, neutrophils natural killer (NK) cells, and dendritic cells. These blood cells are involved in the killing of infectious microbes, in cell-mediated immunity and in the production of specific antibodies against the pathogens. Cu-deficient humans show an exceptional susceptibility to infectious diseases due to the decreased number and function of these blood cells. Besides, Cu can kill infectious viruses such as hepatitis virus, poliovirus, human immunodeficiency virus type 1 (HIV-1), Hepatitis B virus, and several other viruses. Based on available data, we hypothesize that Cu has the potential to kill several viruses, including SARS-CoV-2. Since the current outbreak of the COVID-19 is ongoing, and there is no vaccine or drugs currently available, the critical option is now to make use of the system competent to fight against the SARS-CoV-2. Based on available data, we hypothesize that an increase in plasma copper levels will boost both the innate and adaptive immunity in people. Moreover, the potent antiviral activity, Cu may also act as a preventive and therapeutic agent against COVID-19.

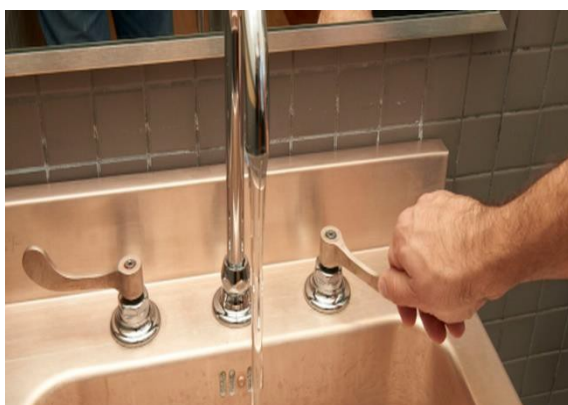
人体にはほとんど無害でありながら感染菌やウイルスに特異的に効くという理由は以下の2つの要因にあるとされています。

1. 銅イオンは菌細胞やウイルスのタンパク質を構成する通常の金属イオン ( $\text{Na}^+$ 、 $\text{Ca}^{2+}$ 、 $\text{Mg}^{2+}$  など) と好んで置き換わり、その成長を止めてしまう。

2. 銅イオン  $\text{Cu}^{2+}$ 、が  $\text{Cu}^+$  に還元されるときに強力な活性酸素を発生する。  
 光触媒が金属銅のイオン化に深く関わっていることは確認しておりますが、その具体的な反応機構までは解明しておりません。  
 未だ推測の域ですが、光触媒の親水性で引きつけられた水分が金属銅のイオン化を促進していると考えております、イオンは水中でしか安定に存在できませんので。  
 しかし、現実のコーティング剤としては「金属銅が主役」「光触媒がその緩慢なイオン化をスピードアップさせる」「陽イオン交換樹脂でもあるナフィオンが発生した  $\text{Cu}^{2+}$  をまんべんなく膜中に分散させる」という理想的な役割分担で、微弱光を間歇的に照射するだけで絶えず長期間にわたり強い殺菌機能を発揮する理想的な殺菌コーティング剤が完成しました。



少し自慢めきますが銅が新型コロナその他の感染症の予防に効果的であるということから欧米では「水道の蛇口、ドアハンドル、手摺り等の人間の手が頻繁に触れる部分を、コストが掛かっても銅製にしよう」という意見が強くなりつつあります。



たしかに感染菌対策としては有効かもしれませんがコスト以外にも「見映えが銅色だけの選択肢になる」と「手入れがたいへん」という新たな問題を抱えてしまいますね。

彼らに「日本にはN F E 2がある！」と教えてやりたいです。

電気化学で多様なナンバーワン創り

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正会員

ホームページへ

