Popular scientific summary

Biological life on Earth exists thanks to the protective ozone layer which filters out most of the ultraviolet (UV) rays that reach the surface of the planet. The UV range is divided into three zones, of which mainly UVA (315-400 nm) and partially UVB (280-315 nm) reach us. Third zone UVC (100-280 nm) which destroys the DNA of viruses and bacteria is absent on the Earth's surface.

It has been proven that diseases such as measles, tuberculosis, and smallpox appeared in the human population with the onset of a sedentary life and herding. These are diseases caused by mutated zoonotic viruses. There is increasing evidence that the current pandemic has been triggered by the SARS-CoV-2 virus which mutated from bats. As the human population increases by occupying areas where wildlife once ruled, we can be expected to be exposed to unknown viruses and the next pandemic. To prepare, today we need to find a way to effectively remove viruses from the surfaces we all touch so often, like handrails, handles, banknotes, etc. Spraying germicides constantly is not good for us (and the environment), we have to find other ways.

Imagine these surfaces are coated with a special powder (phosphor) which, when illuminated by sunlight or a white LED (WLED), will generate UVC radiation which will destroy viruses and bacteria. This is the goal of this project, that is to say, to produce and study the phosphors which will generate effective UVC radiation in the upconversion process, then to study the capacity of these phosphors to disinfect the surfaces which are covered with them.

According to our hypotheses, the disinfection process will be effective when the phosphor is directly excited by solar radiation. However, such a phosphor can also be used to construct miniature UVC light sources excited by diodes. Using such a powder, it will be possible to build drinking water treatment devices and use them wherever there is no electricity.

There is also no concern for our safety. Wavelengths of 222 nm and shorter are retained on the epidermis, that is, dead skin cells, and do not reach the dermis. They are also safe for the eyes because the surface of the cornea stops them. Even after direct illumination of the eyes with such light, a feeling of "sand in the eyes" occur which disappears after 24 hours.

The upconversion process (converting longwave light to shortwave light) has been known since 1966 of the last century and today is mainly used to protect documents and banknotes from counterfeiting. We have experience in the synthesis and research of such phosphors. So let's keep your fingers crossed that we can create a new material that will be very useful in the future.