Vyv Antimicrobial LED Technology and Viruses

Frequently Asked Questions

Vyv recently announced the efficacy of its antimicrobial light technology for inactivation of viruses. The antimicrobial effects of visible light (405nm) on bacteria, mold, fungi, and yeast have been well-studied and documented for many years. Only recently have active investigations been conducted on the effects of these antimicrobial lights on non-enveloped viruses and enveloped viruses. The results of these tests have verified the antimicrobial impact on multiple classes of viruses. Below are frequently asked questions about Vyv's impact on viruses with Vyv's responses:

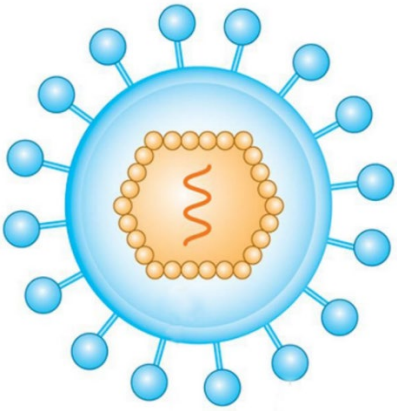
1. What is the difference between a non-enveloped virus and an enveloped virus?

   Viruses can infect human, animal plant or bacterial cells, and they can be classified based on two criteria: their type of genetic material (DNA or RNA) and their structure, like being enveloped or non-enveloped. The structure of all viruses includes a protein shell called a "capsid".

   Enveloped Viruses

   Enveloped viruses have an additional layer that covers the capsid. This membrane is composed of lipids and proteins it "stole" from the host cells and viral glycoproteins (sugars combined with proteins). The bumps, knobs, and spikes that artists use in images of enveloped viruses like SARS-CoV-2 depict structures on the viral envelope. These types of viruses need both an intact capsid and the envelope to infect cells. The envelope also helps avoid detection by the host immune system because it makes the virus look like just another host cell. But the envelope also provides a soft target for destroying the virus when it is outside the host. Common disinfectants, and even alcohol, detergents or soap can disrupt the oily envelope and its components, destroying the ability for the virus to infect host cells.

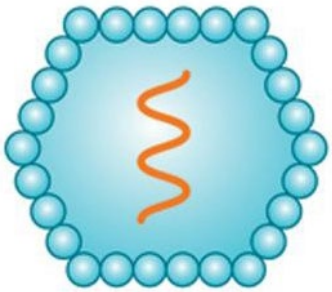
   Enveloped viruses can cause persistent infections and must be transferred from host to host. Examples of enveloped viruses include ones that cause diseases in humans, such as COVID-19, Influenza, Hepatitis B and C, and Hemorrhagic Fever (Ebola Virus Disease).



Enveloped Virus

Non-enveloped Viruses

Non-enveloped viruses do not have a lipid covering, but their effects on humans can be just as devastating. These "naked" viruses only need their protein-based capsid and host detector proteins to infect host cells. However, because they lack a lipid envelope, they are more resistant to many disinfectants and other stresses like drying out or heat exposure. Examples of non-enveloped viruses include types that can cause dysentery (Norovirus), common colds (Rhinovirus) and Polio (Poliovirus).



Non-Enveloped Virus

2. What tests were performed that indicate 405nm visible light can inactivate viruses?

Performed through a certified third-party testing lab, Vyv's first studies were done using non-enveloped viruses. Non-enveloped viruses were chosen for the first studies primarily because these viruses are harder to destroy or inactivate than enveloped viruses. Enveloped viruses have a membrane in addition to the protein coat. This membrane is relatively fragile and can more easily be disrupted to inactivate this class of virus.

Recent studies performed by several independent labs and institutions have shown that light in the 405 nm region was additionally able to inactivate enveloped viruses. These results converge to demonstrate efficacy, in various testing conditions, on both enveloped and non-enveloped viruses. This will also encourage more research to enhance the understanding of the effects of 405 nm light on viral components.

3. What were the results of Vyv's third-party tests?

Vyv's testing, performed by a third-party independent testing laboratory (Microchem, TX, USA), was conducted using MS2, which is a non-enveloped virus.

After 6 hours dried from a standard saline solution, over a 3.82 log reduction (99.985%) was achieved. After 6 hours dried from artificial saliva, a 2.23 log reduction (99.41%) was achieved. This testing was conducted at 2 mW/cm^2, as a starting point, using one of Vyv's laboratory testing benchtop units. This would represent a generally higher light level than what would be expected in an overhead room application. However, the benchtop test unit is designed to adjust luminosity to replicate various room lighting conditions as testing protocols expand to continue to test various conditions and intensities. Additionally, external 3rd party research labs have pre-published viral efficacy data on 405nm wavelengths at lower intensities, similar to an expected overhead room environment.

4. How does 405nm light kill/inactivate viruses?
   Based on currently available research literature, it is suggested that 405 nm light can destabilize the membrane of enveloped viruses and to a lesser extent the protein coat of non-enveloped viruses (though the potency of the effect may increase in biological fluids). A definitive answer to the mode of action of 405 nm light during the demonstrated inactivation of viruses is still on the horizon.

5. How long can viruses live on surfaces?
   Virus-laden droplets may remain infectious for several hours, depending on where they fall. Viruses generally remain active longer on stainless steel, plastic, and similar hard surfaces than on fabric and other soft surfaces. Other factors, such as the amount of virus deposited on a surface and the temperature and humidity of the environment, also determine how long viruses stay active outside the body.

   It is possible to catch a virus, like the flu or a cold, after handling an object an infected person sneezed or coughed on a few moments ago. While each specific virus is different and unique, personal contact with an infected person — such as a handshake or breathing in droplets from a cough or sneeze — can be the most common way these viruses spread.

6. How long does it take for Vyv antimicrobial LED lights to inactivate and kill viruses on surfaces?
   After 6 hours dried from a saline solution, over a 3.82 log reduction (99.985%) was achieved on a non-enveloped virus (MS2). After 6 hours dried from artificial saliva, a 2.23 log reduction (99.41%) was achieved with this same virus. Results may vary depending on the amount of light that is reaching the surfaces in the space where Vyv's technology is installed and the length of time of exposure.

7. Can people be exposed to Vyv antimicrobial light that impacts viruses?
   Yes. Vyv antimicrobial lights fall within the visible light spectrum (400-420nm), outside the spectrum of potentially damaging UV (ultraviolet) light. Vyv LED technology meets international standards (IEC62471) for continuous and unrestricted use around people, animals, and plants. These same lights are used when addressing viruses, bacteria, fungi yeast or mold.

8. Are people safe from viruses when they are under these lights? Do we still need to social distance and wear masks while under these lights?
   Many viruses are spread from host-to-host (person-to-person). Although viruses can be picked up from touching surfaces where the virus has been deposited, viruses like SARS-CoV-2 are mostly spread through airborne transmission (person-to-person). Vyv technology will not mitigate person-to-person transmission. While under Vyv lights it remains important to follow CDC guidelines of mask wearing, social distancing and washing hands.

9. What is the difference between a virus and a bacterium?
   Bacteria and viruses are both small, but bacteria are in fact are very complex organisms that can and do adapt constantly to their environment, the available nutrients, and even the size of the bacterial crowd they inhabit. Viruses are extremely simple, lacking any means of energy production, environmental sensing, or response, and cannot reproduce without the taking over the machinery of a larger, complex living cell ("a host").

10. What is a host?

    A host is the living cell of an animal, plant, or bacterium that a virus uses as a factory to reproduce and spread itself. Viruses on their own are inert – but once inside a host cell they commandeer the cell's complex biological systems to make numerous copies of themselves and release them into the environment to continue their existence.

11. Are viruses living microbes?

    Most scientists would say no because viruses cannot reproduce (replicate) without a host or remain viable in the environment outside of a host. Being able to replicate oneself is generally accepted as a central tenet of the definition of life.