

Future Possibilities on Curie Biotech

April 18, 2021

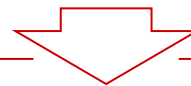
Masks serve as the 1st line of defense against COVID-19; however, their effectiveness is often lacking

Masks only have a 25%-75% protection rate against the COVID-19 virus

- A study conducted by the University of Hong Kong showed that hamsters who were protected by a surgical mask partition still had a 25% chance of being infected by the COVID-19 virus*
- A study conducted by Boston University showed that masks can only contribute 15%-25% efficiency on stopping transmission of COVID-19 mutation**

Consequently, frontline healthcare workers have suffered disproportionately, despite their PPE

- Frontline healthcare workers, who are typically equipped with the highest grade of masks and PPE, experience high levels of infection.
- In November 2020, *The International Journal of Infectious Diseases* found that approximately 300,000 healthcare workers from 37 countries had been infected with COVID-19.
- The CDC estimates that more than 415,000 healthcare personnel in the United States had been infected, with close to 1,400 dying from the disease



There is a need for an effective and affordable solution that can capture and kill the COVID-19 virus

*Surgical mask partition reduces the risk of non-contact transmission in a golden Syrian hamster model for Coronavirus Disease 2019 (COVID-19)

Source: The University of Hong Kong

**Mask-wearing and control of SARS-CoV-2 transmission in the USA: a cross-sectional study

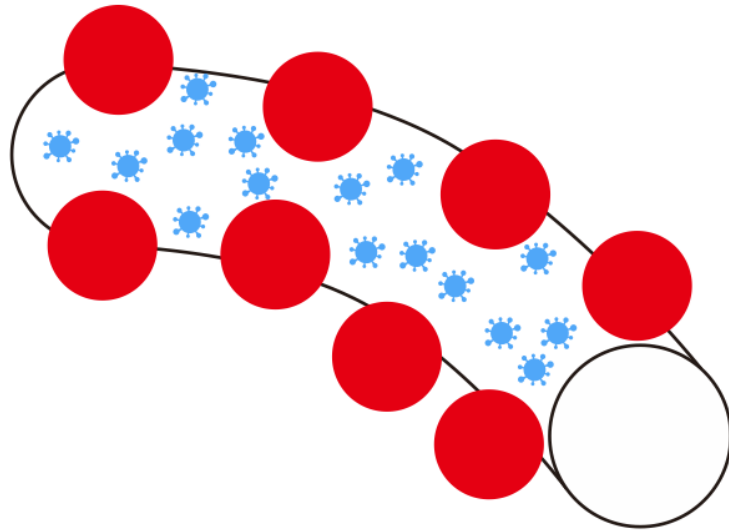
Source: The Lancet


Promising conclusion from Finland study on Curie biotech

- Have a clear ability to
 - **Arrest** and **Inhibit** coronavirus and enterovirus with a **99.9%** ratio
 - 99.9% reduction after short incubation time (**5 mins**)
 - **Rapid effect** on the viruses
 - **No Cytotoxicity** to **human lung cells** for mask applications and other external applications
- Enterovirus and coronavirus are structurally different
 - Highly likely to **achieve similar results** with **other viruses** as well (Wide spectrum of viruses)
- A **promising substance** for masks and other applications that aim at **preventing virus spread**

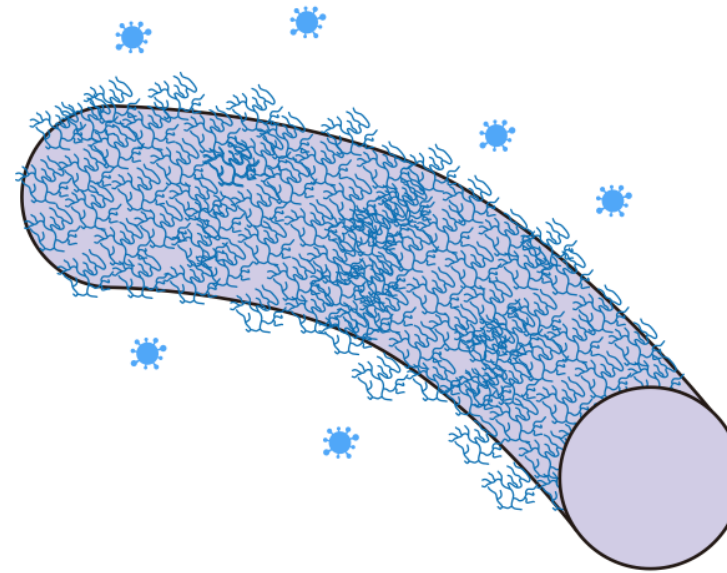
To address this challenge, Curie has developed a polymer to “capture and kill” COVID-19 > 99.9% effectiveness within 5 mins



Other Antiviral Mask



-  Heavy Toxic Ingredients
-  COVID survive in the gap between active ingredients

Curie Polymer



-  Curie Polymer (Evenly and Durably Bonded on Surface)
-  COVID is difficult to hide

We do this by using a positively charged polymer to capture and kill biohazards like COVID-19 (1/2)

① Strong positive charged polymer attract negative charged protein based biohazard like COVID-19

② Polymer arrest biohazard like COVID-19

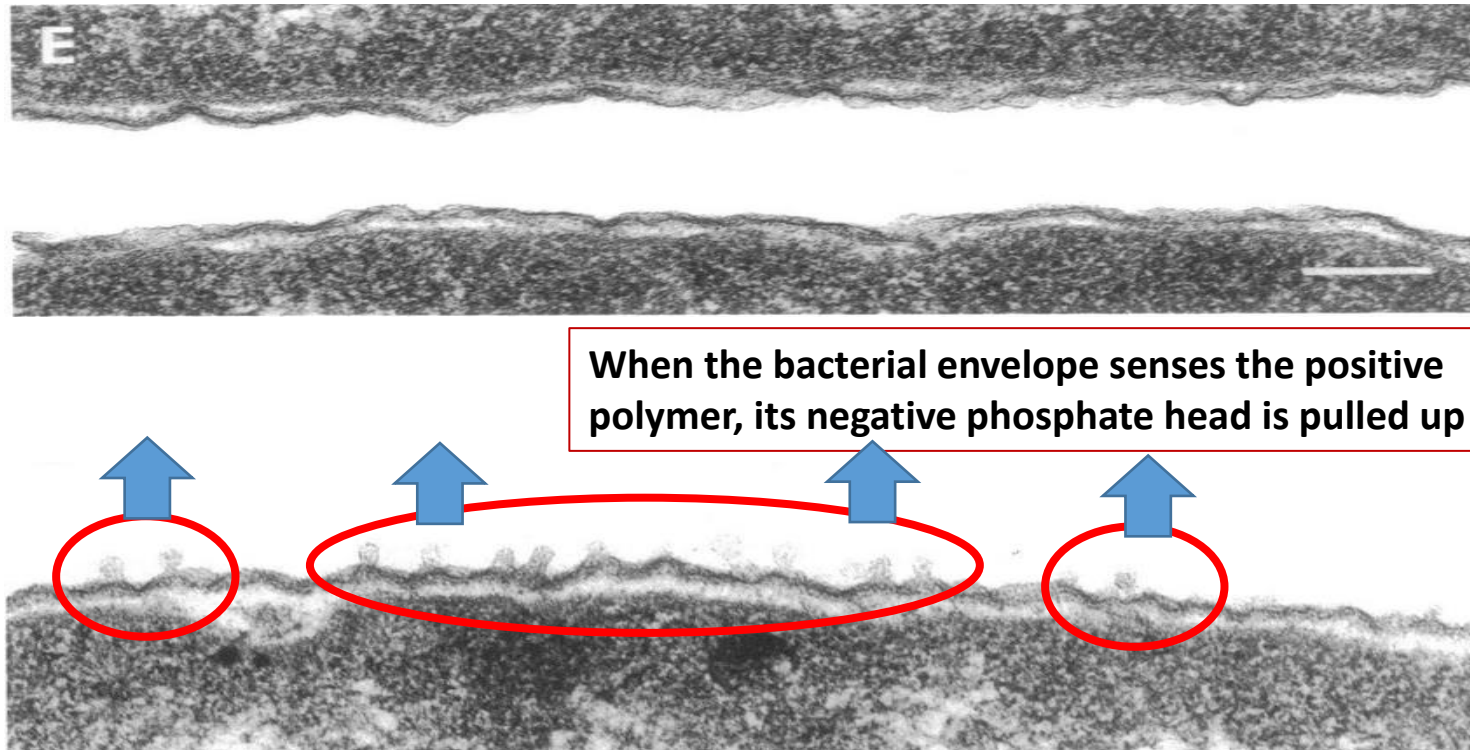
③ Polymer tear off envelope of biohazard like COVID-19



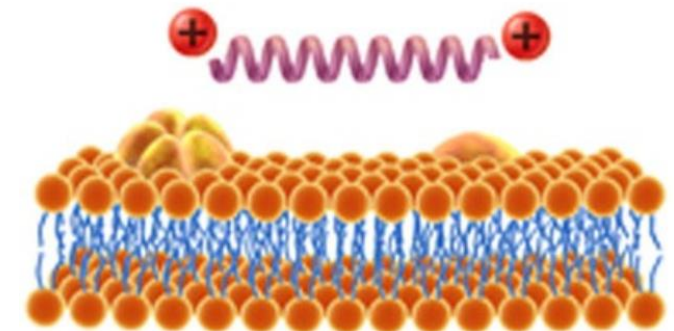
We do this by utilizing a positively charged polymer to capture and kill biohazards like COVID-19 (2/2)

Microscopic view

Normal Bacterial Envelope



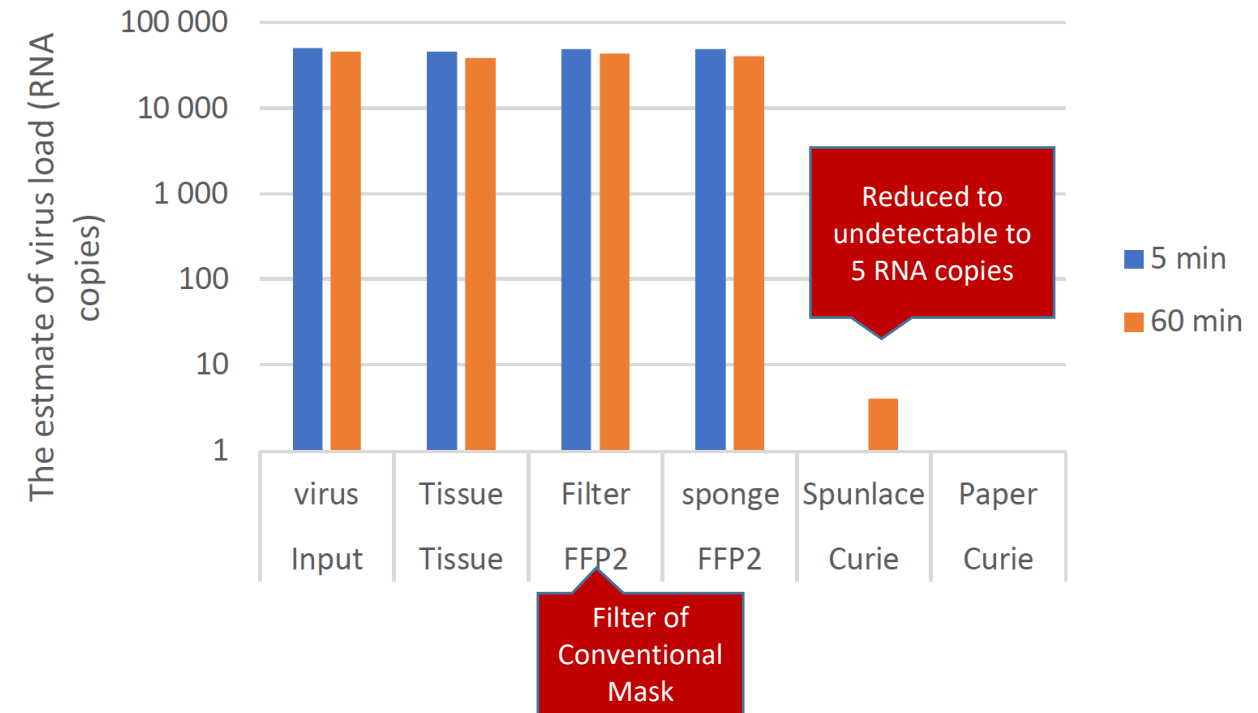
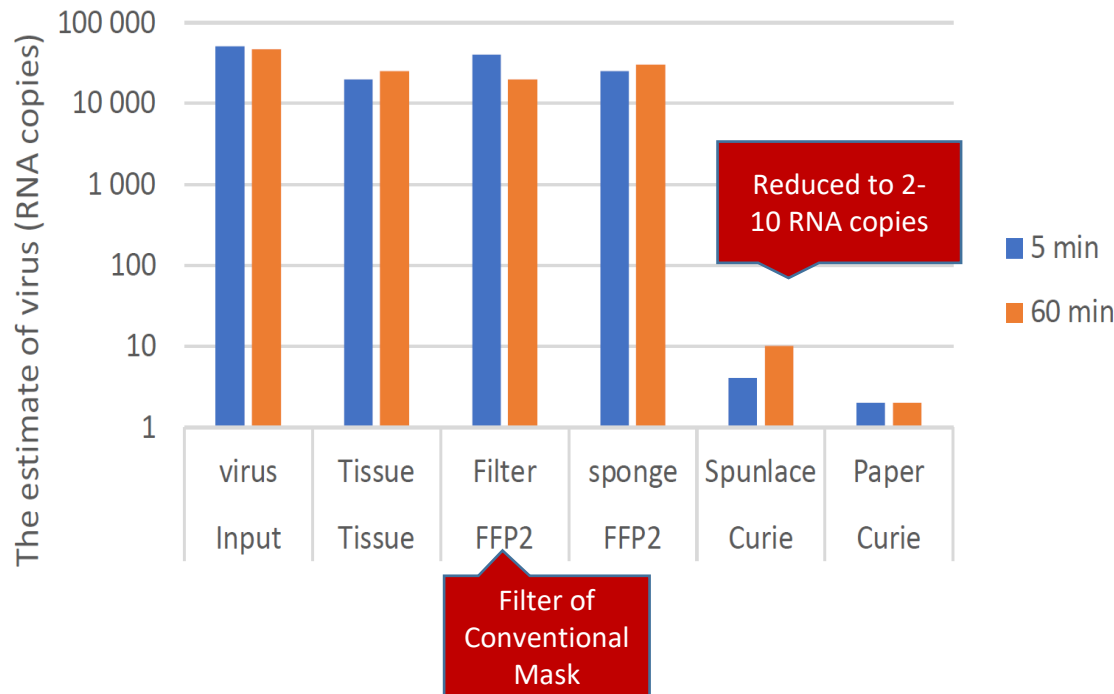
Visual representation



A study conducted by Finland Tampere University proved that Curie significantly reduced COVID-19 virus substitutes*

Curie biotech significantly reduced SARS-229E RNA copies compared to controls (tissue, FFP2 filter, FFP2 sponge)

Curie biotech significantly reduced Coxsackievirus-B6 RNA copies compared to controls (tissue, FFP2 filter, FFP2 sponge)

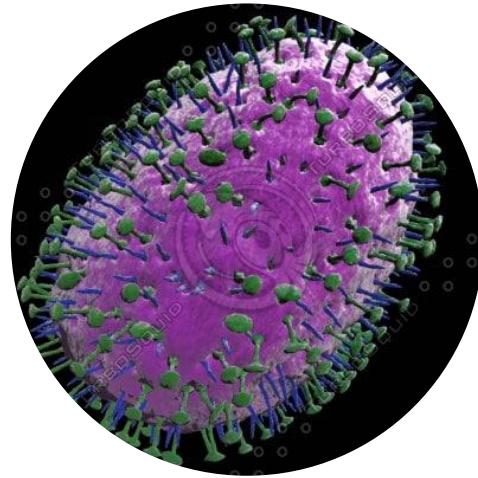


* Both SARS-229E and Coxsackievirus-B6 are accepted substitutes for the SARS-CoV-2 virus
Source: Finland Tampere University, 2021

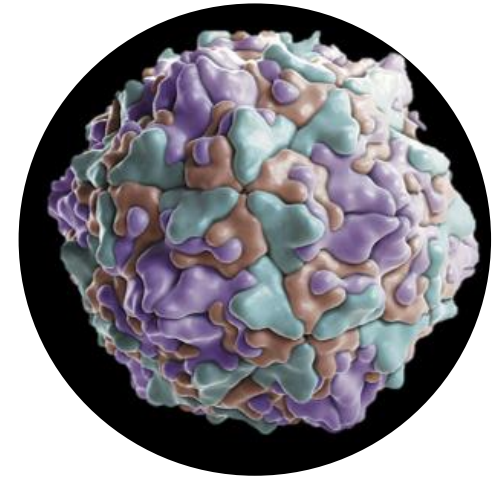
This study demonstrate that Curie biotech exhibits capture and kill against many forms of virus



SARS-CoV-2 / SARS-229E
(Spike Protein + Envelope)



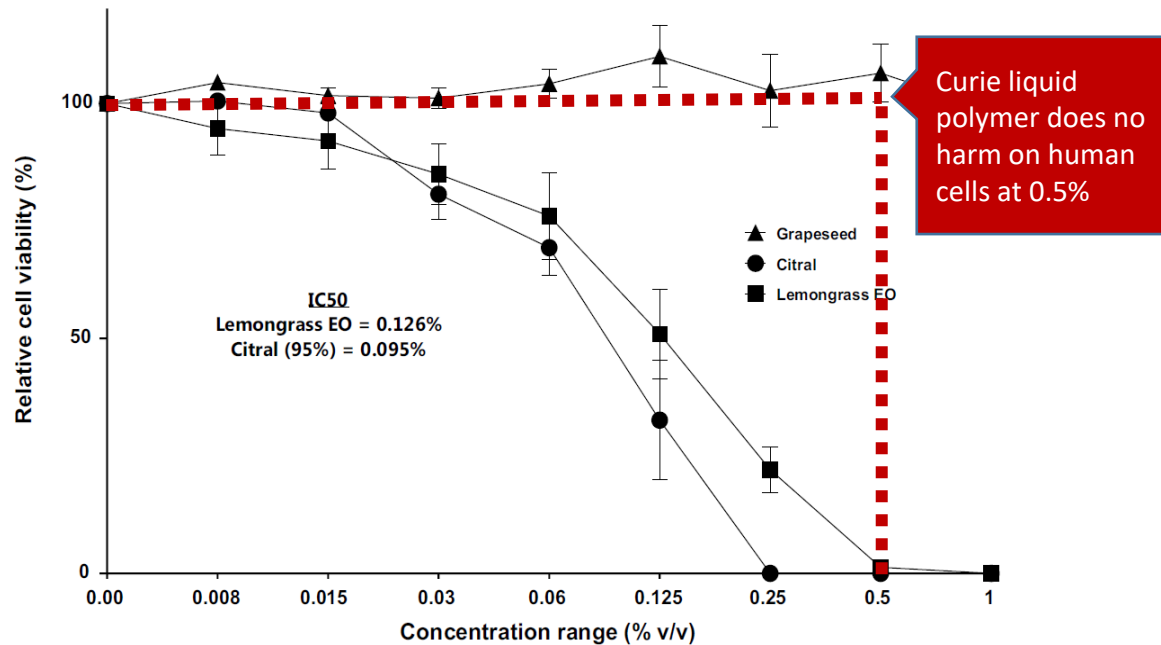
H3N2
(Pleomorphic Envelope)



Coxsackievirus-B6
(Non-Enveloped, Icosahedral
Capsid)

A study conducted by Finland Tampere University and Czech Academy of Science proved that cytotoxicity of Curie are better than some natural food additives

Curie liquid polymer is even safer than natural food additives such as Grapeseed, Citral and Lemongrass*



- Finland Tampere University:
 - Liquid polymer was directly applied on human lung cell
 - To simulate polymer of the filter fabric is peeling off under stress test
 - 0.5% of liquid polymer (12.5% of total polymer) does no harm on human lung cells
- Czech Academy of Science:
 - Filter fabric is vortexed 5-times for 5 seconds to wash out polymers on the filter fabric
 - 4% solid polymer on filter fabric does no harm on cells**
- Curie biotech does not have toxic effect on mask or similar application

* Cytotoxicity of Grapeseed, Citral and Lemongrass

Source: Antimicrobial activity, cytotoxicity and chemical analysis of lemongrass essential oil (*Cymbopogon flexuosus*) and pure citral, from the University of the West of England, Bristol

** Complete report shall be ready within April 2021

Source: Virology Research-Service Group, Institute of Organic Chemistry and Biochemistry of the Czech Academy of Science

A study conducted by Hong Kong Open University proved that Curie biotech significantly killed 99.9% bacteria within 1 mins


























Results:

Specimen	Conditions	Number of bacteria ^a (CFU per specimen)
#1	Shake-out before incubation	0
#2	Shake-out after incubation	0

^a1 millilitre of an inoculum of *Staphylococcus aureus* with concentration of 1×10^6 CFU/ml to 3×10^6 CFU/ml was applied onto an agar plate in the transfer method, where each specimen was set on the agar surface and weigh down with a 200 g stainless-steel cylinder for $60 \text{ s} \pm 5$ s to transfer the microbial content. Incubation Measurement of the number of bacteria colonies was conducted in accordance with the plate count method specified in Annex C of BS EN ISO 20743:2013.

- Have a clear ability to
 - **Kill** high dosage of Staphylococcus Aureus with a **99.9%** ratio
 - 99.9% reduction after short incubation time (**1 mins**)
 - **Rapid effect** on the bacteria

Curie biotech compares favorably against potential competitor products across several key dimensions on mask application

	Our product	Potential competitors			
	Curie Biotech	Disinfectant on meltblown mask	I3 Biomedical	Zen Graphene	Pharm2Farm
How does it work?	Uses a strong positively charged polymer to capture and kill negatively charged COVID virus	Kills virus on a normal mask's outer surface by applying a disinfectant spray	Kills virus using the cytotoxicity of iodine	Kills virus using the cytotoxicity of graphene	Kills virus using the cytotoxicity of copper
Does it capture the virus in fast air flow?	 Research showed that Curie was able to capture more than 99.9% of the virus and bacteria in fast air flow	 Applying disinfectant on a mask does not result in the mask capturing the virus	 Iodine does not generate extra attractive force towards the virus	 Graphene does not generate extra attractive force towards the virus	 Copper does not generate extra attractive force towards the virus
Does it kill 99.9% of the virus in a short time frame?	 Research showed that Curie was able to kill 99.9% of the virus and bacteria in a short time frame	 Water in disinfectant discharges electrostatic force, reducing filtration efficiency of the mask. Disinfectant disappears after 5 minutes due to volatility	 Deactivates 99% -- but not 99.9% -- of the virus within minutes	 Research showed it was able to kill 99% of the virus in 35 days	 Research showed that it was able to kill 90% of the virus in 7 hours
Is it non-toxic?	 Safer than natural food additives	 Continual and frequent exposure to disinfectant damages the user's lung tissue	 No toxic effects on humans	 Graphene has toxic effects on humans, Health Canada ban it	 Copper contains nanoparticles that have heavy toxicity against the human body
Is it non-metallic?	 Curie does not contain metals (e.g. toxic metals like zinc, copper, or titanium)	 Disinfectant is made of isopropyl alcohol. It does not contain metals	 Does not contain metals	 Graphene is not a metal	 Copper is a heavy metal
Is it biodegradable?	 The Curie polymer is 100% biodegradable and causes no environmental damage	 Applying disinfectant on a meltblown mask does not result in biodegradability	 I3 Biomedical masks are not biodegradable and take centuries to degrade in landfills	 Zen Graphene masks are not biodegradable, and take centuries to degrade in landfills	 Copper is not biodegradable and results in soil pollution

Air filter serve as the 2nd line of defense against COVID-19; however, their effectiveness is often lacking

UVC required high dose and long duration to inactivate virus, while contact time of air with UVC treatment is extremely short

- A study conducted by Columbia University Center for Radiological Research discovered UVC long exposure to inactive coronavirus*
 - 90%: 8 Mins
 - 95%: 11 Mins
 - 99%: 16 Mins
 - 99.9%: 25 Mins
- Ineffective to inactivate coronavirus even when direct irradiating by UVC, from FDA recommendation**
- More difficult to inactivate of pathogen embedded in dust, soil, or other particulates with porous surface

Other risks and drawback of using UVC

- Accelerate the aging of filter bag and cause degradation of the certain materials in the air conditioning system
- Generate irritating ozone gas
- Release of toxic mercuric fume when the UVC tube is broken
- Consuming of electricity



need for an effective and affordable solution that can arrest and kill the COVID-19 virus

* Far-UVC light (222nm) efficiently and safely inactivates airborne human coronaviruses

Source: Columbia University

** UV Lights and Lamps: Ultraviolet-C Radiation, Disinfection, and Coronavirus

Source: US Food & Drug Administration

FDA stated clearly on the risk of UVC in air conditioning system

Q: Is it safe to use a UVC lamp for disinfection purposes at home?

A: Consider both the risks of UVC lamps to people and objects and the risk of incomplete inactivation of virus.

Risks: UVC lamps used for disinfection purposes may pose potential health and safety risks depending on the UVC wavelength, dose, and duration of radiation exposure. The risk may increase if the unit is not installed properly or used by untrained individuals.

- Direct exposure of skin and eyes to UVC radiation from some UVC lamps may cause painful eye injury and burn-like skin reactions. Never look directly at a UVC lamp source, even briefly. If you have experienced an injury associated with using a UVC lamp, we encourage you to [report it to the FDA](#).
- Some UVC lamps generate ozone. Ozone inhalation can be irritating to the airway.
- UVC can degrade certain materials, such as plastic, polymers, and dyed textile.
- Some UVC lamps contain mercury. Because mercury is toxic even in small amounts, extreme caution is needed in cleaning a lamp that has broken and in disposing of the lamp.

Effectiveness: The effectiveness of UVC lamps in inactivating the SARS-CoV-2 virus is unknown because there is limited published data about the wavelength, dose, and duration of UVC radiation required to inactivate the SARS-CoV-2 virus. It is important to recognize that, generally, UVC cannot inactivate a virus or bacterium if it is not directly exposed to UVC. In other words, the virus or bacterium will not be inactivated if it is covered by dust or soil, embedded in porous surface or on the underside of a surface.

Degraded of filter bag by UVC exposure, resulting in leakage of dusts including pathogens to the outlets and ducting



(Exposed to UVC around 1 month)

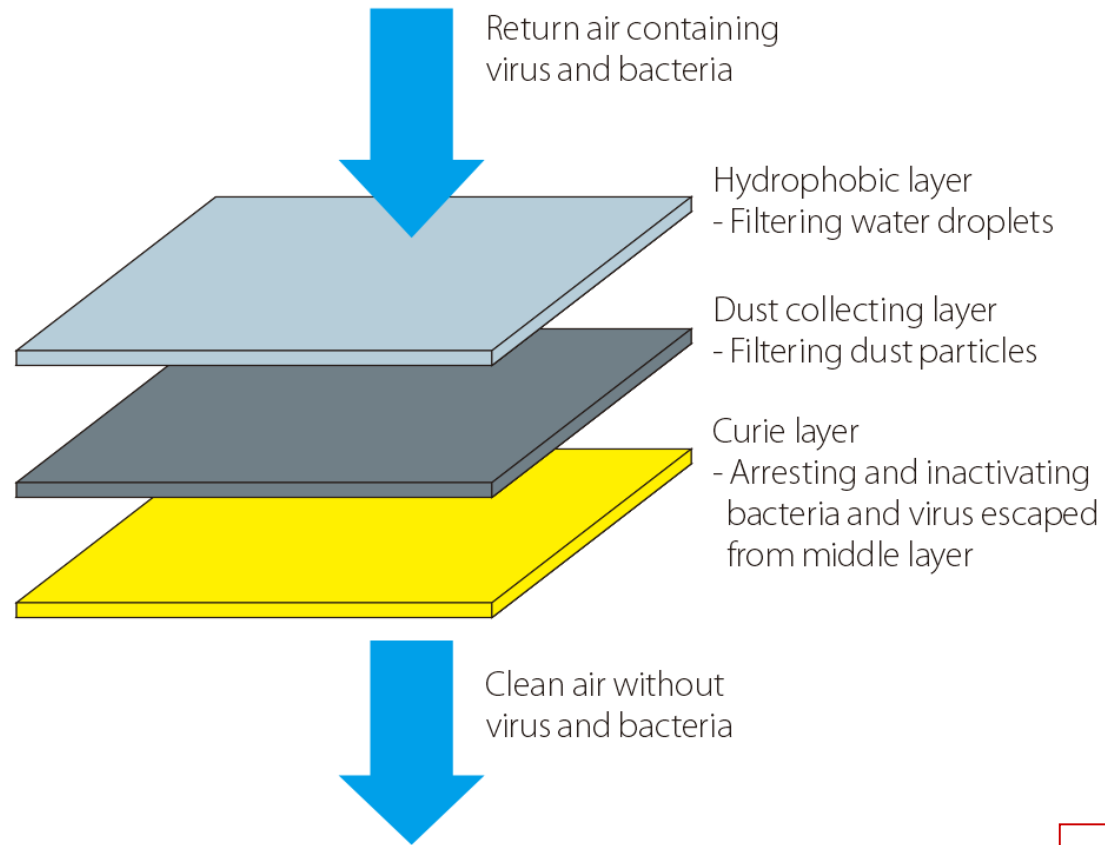
Testing results after 1 week of on-site operation in Hong Kong shopping mall, conducted by the Open University of Hong Kong

- Antibacterial activity of the outer layer of filter bag after the trial run
 - In accordance with BS EN ISO 20743: 2013 Clause 8.2
 - Transfer *Staphylococcus Aureus* onto the outer layer of filter bag
 - Compare the number of colonies results before and after 24 hours incubation of the contaminated outer layer

	Colonies found before incubation	Colonies found after incubation	Antibacterial Activity Value	Antibacterial Activity (%)	Remark
Sample A	6	0	6.54	> 99.99%	Curie Treated
Sample B	5	0	6.54	> 99.99%	Curie Treated
Sample C	10	25,600,000	0.13	-	Untreated
Sample D	13	28,800,000	0.20	-	Untreated

- **Reduction** of more than **1,000,000 fold** of *Staphylococcus Aureus* growth by **Curie filter**
- **2.56M - 2.88M folds** on *Staphylococcus Aureus* **growth** on **untreated filter**
- **No efficiency lost** on antiviral / antibacterial performance **under strong air flow** and **harsh condition**

Using Curie material to arrest and inactivate COVID-19 and other pathogens in air-conditioning system




























To apply Curie material at the outer lay of filter bag

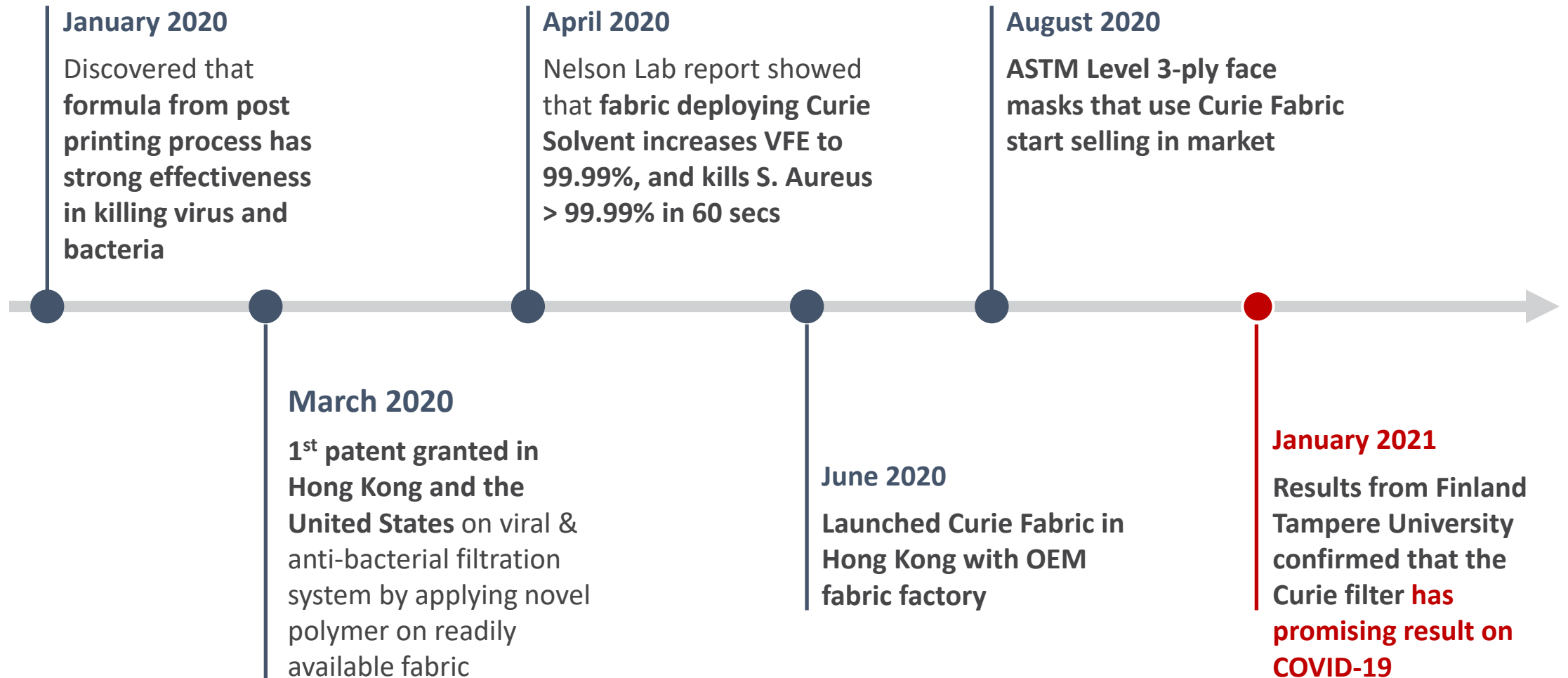
- As the gate keeper to inactivate bacteria and virus leaking from filter bag
- Demonstrated strong efficiency on arresting and inactivating wide ranges of viruses and bacteria
- Non-cytotoxic to human lung cells and safe to use
- No negative effect on the performance of air conditioning system
- Easy to apply to existing filter bag units
- Saves electricity and maintenance costs when comparing with UVC modules

An easy, effective, affordable and well proven solution that can arrest and kill the COVID-19 virus

Curie biotech compares favorably against potential competitor products across several key dimensions on filter application

	Our product	Potential competitors			
	Curie Biotech	HEPA Filter	UVC	Silver / Copper / Zinc / Titanium	Nanofiber
How does it work?	Uses a strong positively charged polymer to capture and kill negatively charged COVID virus	Uses multiple layers of meltblown to capture COVID virus	Kills virus by electromagnetic radiation	Kills virus using the cytotoxicity of heavy metal	Uses high density fabric to capture COVID virus
Does it capture the virus in fast air flow?	 Research showed that Curie was able to capture more than 99.9% of the virus and bacteria in fast air flow	 Captures virus in fast air flow by high density of fabric	 Does not capture any virus in fast air flow	 Does not capture any virus in fast air flow	 Captures virus in fast air flow by high density of fabric
Does it kill 99.9% of the virus in a short time frame?	 Research showed that Curie was able to kill 99.9% of the virus and bacteria in a short time frame	 Does not kill any virus, virus can survive in HEPA filter for 7 days	 Deactivates 99.9% of the virus in 25 mins	 Deactivates 99.9% of the virus in long time frame	 Does not kill any virus, virus can survive in nanofiber for 7 days
Is it non-toxic?	 Safer than natural food additives	 No toxic effects on humans	 Emit ozone to cause skin irritation	 Toxic effects on humans, FDA and Health Canada ban it	 No toxic effects on humans
Is it easy to deploy?	 Easy to fix on air conditioning system, by adding 1 layer only	 Limit to air conditioning system with strong air flow only	 Needs extra electricity and installation	 Easy to fix on air conditioning system, by adding 1 layer only	 Limit to air conditioning system with strong air flow only
Does it have low pressure drop?	 Low pressure drop, without significant lost in efficiency	 High pressure drop, resulting significant lost in efficiency	 No pressure drop, without significant lost in efficiency	 Low pressure drop, without significant lost in efficiency	 High pressure drop, resulting significant lost in efficiency

We have made the following progress since 2020...



... And secured a wide range of certifications and patents

Safety

- Cytotoxicity on Human Lung Cells
- Cytotoxicity on Green Monkey Kidney Cells
- ISO10993
- EN ISO 21084:2019
- EN ISO 18254:2016
- EN ISO 14184:2011
- JIS L 1041
- DIN EN ISO 17070:2015
- 64 LFBG B 82.02-08
- EN ISO 14389:2014
- US CSPC-CH-C1001-09.4

Patents

- U.S. provisional patent
- HK short term patent
- Patent Cooperation Treaty

Flat mask / Respirator

Flat mask

- ASTM F2100 / F2101 Level 3
- CE EN14683 Type IIR
- Intertek Tick Mark
- Australia ARTG

Respirator

- CE EN149 FFP2 (N95 Standard)
- CE EN149 FFP3 (N99 Standard)

Antiviral / Anti-bacterial activity & filtration efficiency

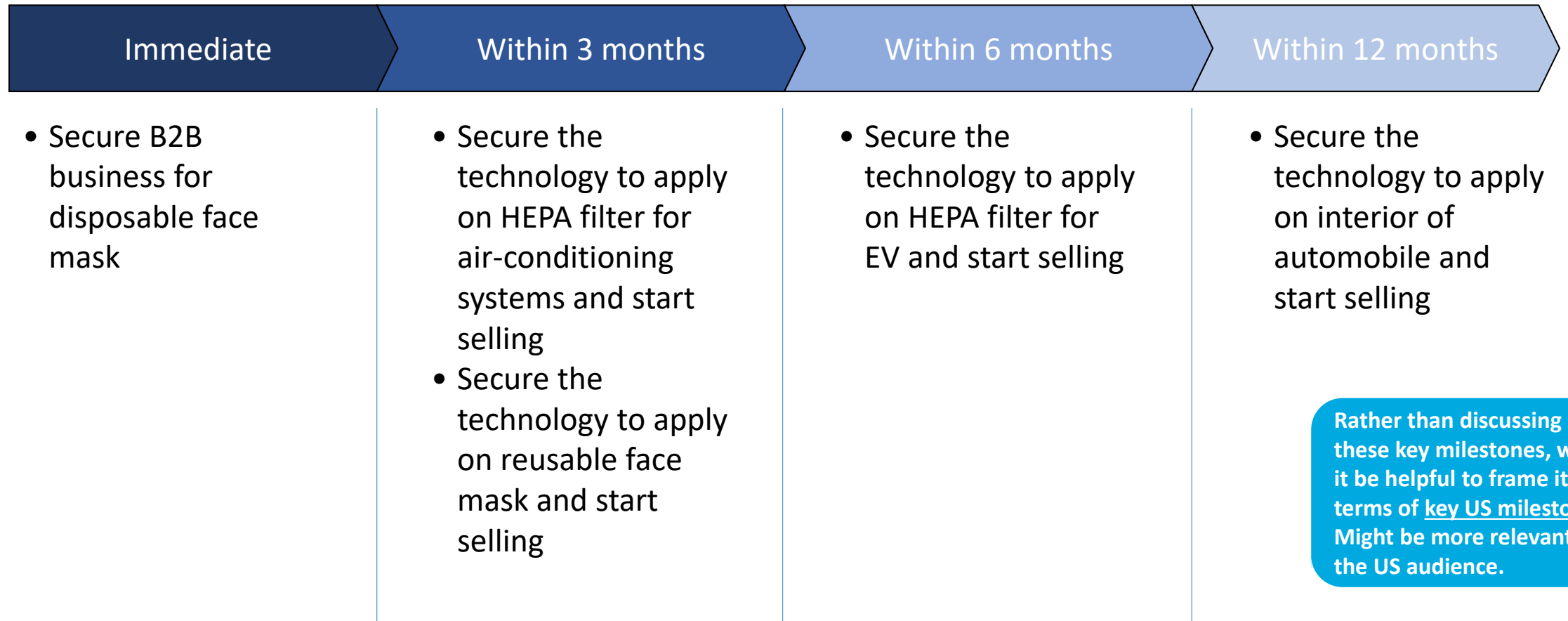
Antiviral / Anti-bacterial activity

- Killing SARS-229E (5 mins / 60 mins)
- Killing Coxsackievirus B6 (5 mins / 60 mins)
- Killing SARS-CoV-2 (2 hrs)
- Killing H3N2 (2 hrs)
- Killing Staphylococcus Aureus (1 min)

Filtration efficiency

- Viral Filtration Efficiency (VFE)
- Bacterial Filtration Efficiency (BFE)

Next 12 months, we hope to achieve the following key milestones



Rather than discussing these key milestones, would it be helpful to frame it in terms of key US milestones? Might be more relevant to the US audience.