

Supporting Information

Carbon Nanotube Mask Filters and their Hydrophobic Barrier and Hyperthermic Antiviral Effects on SARS-CoV-2

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1. Structural composition of the SMS filter of the face mask

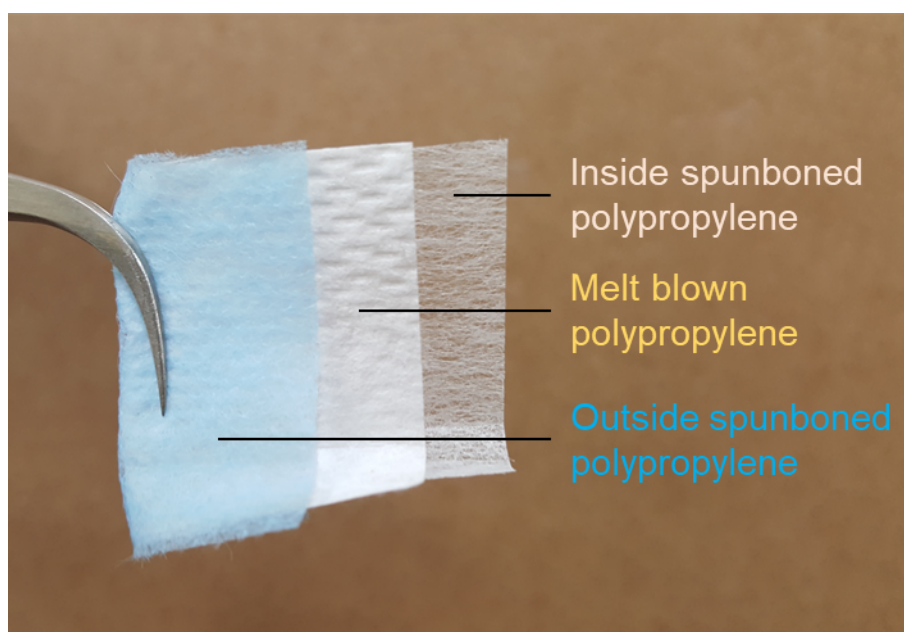


Figure S1. Structural composition of the SMS filter of the dental mask.

2. CNT Film Production

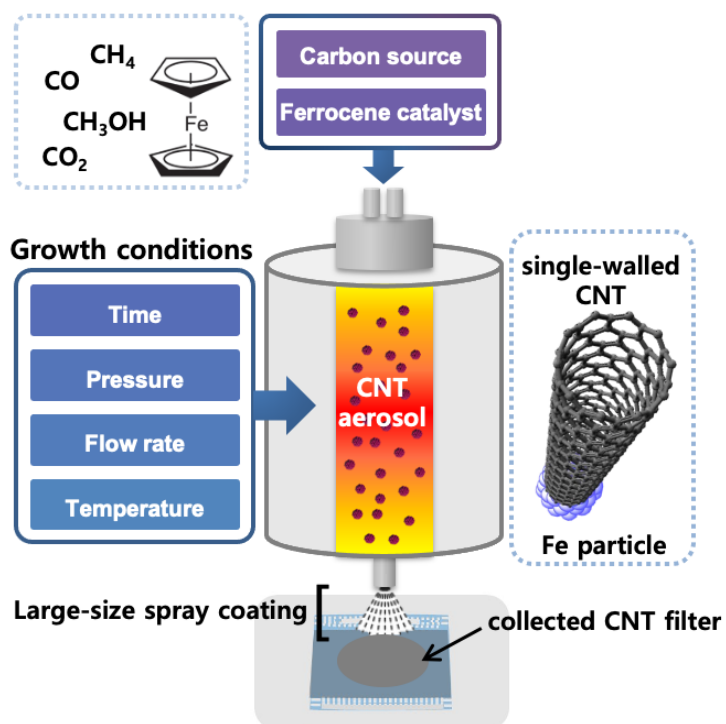


Figure S2a. Graphical illustration of aerosol-synthesized chemical vapor deposition (CVD).

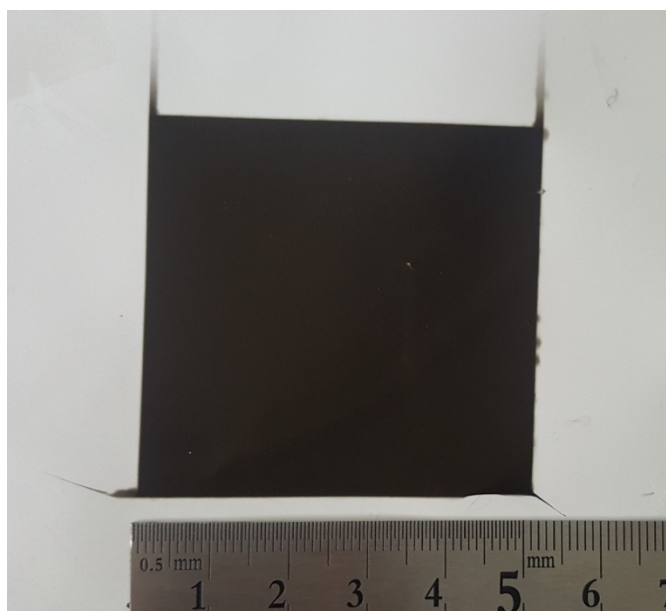


Figure S2b. Photographic image of the large-size D-CNT using the aerosol-synthesized CVD.

3. Durability of SMS filter and CNT

Table S1. The contact angle table to check durability of filters for 5 days as well as after heat sterilization.

filter	contact angle				
	Day1 (°)	Day2 (°)	Day3 (°)	Day4 (°)	70 °C, 15 min
CNT	131.8 ±3.8	133.3 ±3.6	132.5 ±3.4	133.3 ±3.6	132.2 ±2.9
SMS	125.4 ±3.2	122.1 ±3.8	120.9 ±4.0	117.3 ±10.4	104.9 ±5.5

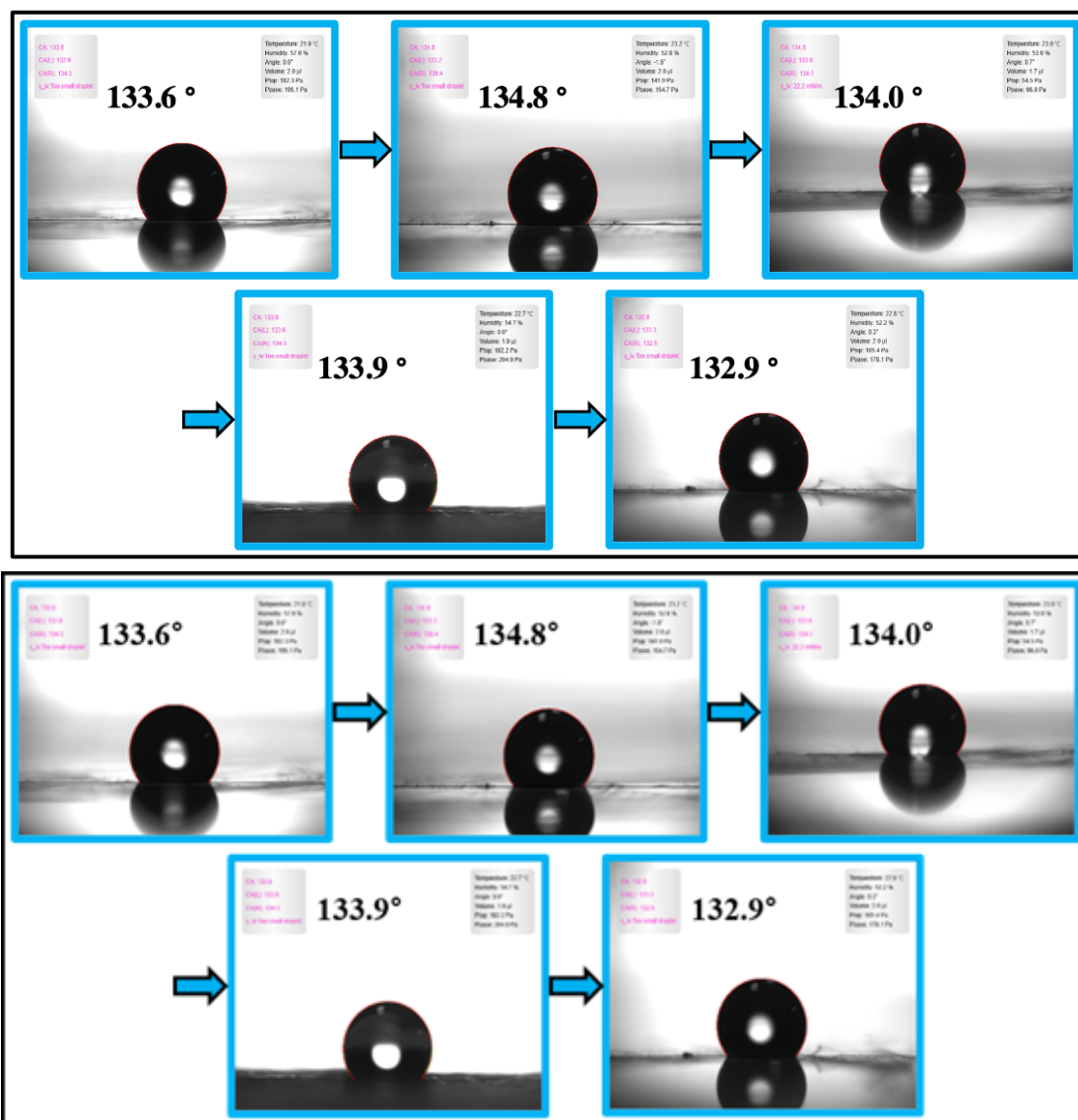


Figure S3a. Photographic images of the water droplets on CNT demonstrating the durability of the CNT filter.

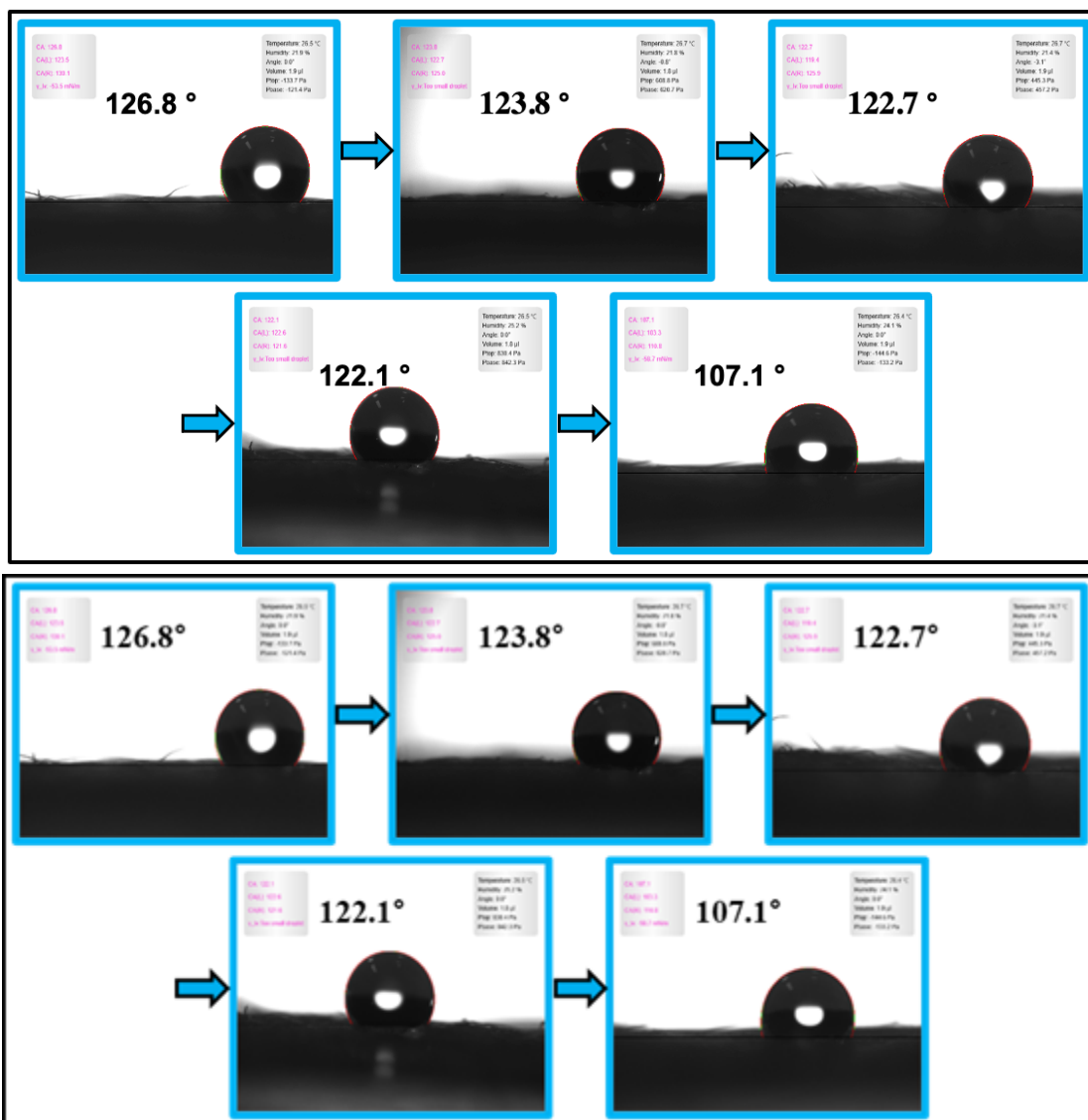


Figure S3b. Photographic images of the water droplets on SMS filter over 4 d.

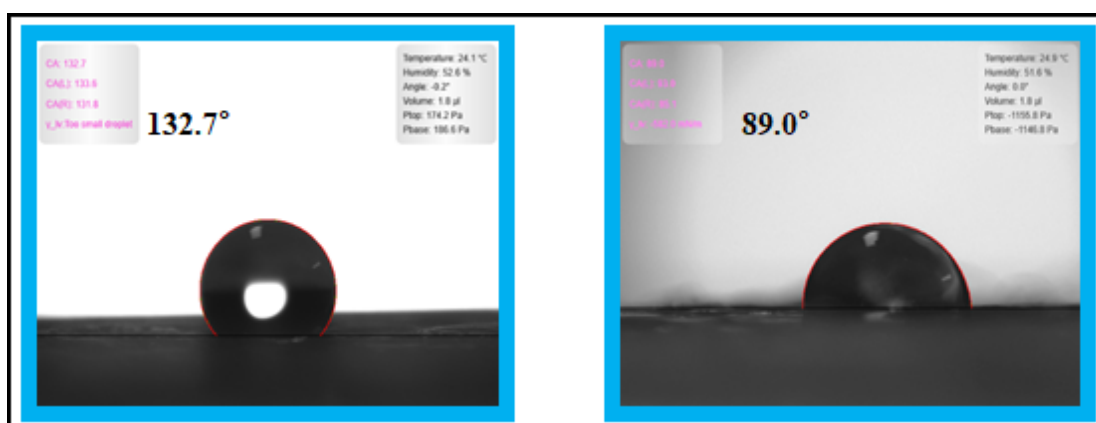


Figure S3c. Comparison of the contact angles of a relatively new CNT and a few years old CNT. It is indicated that oxidation of CNT takes place over a long term and the hydrophobic effect of the CNT filter is semipermanent.



Figure S4. Measured value of water contact angle by substrate a) glass, b) plastic, and c) SMS filter.

4. SEM images of the SMS filter

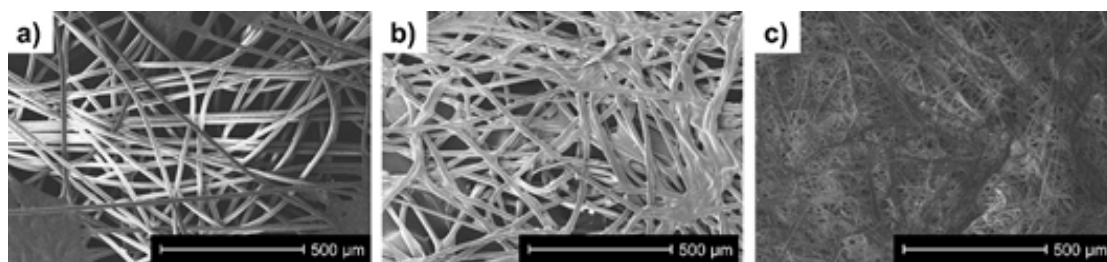


Figure S5. Top view SEM images of the SMS filter separately. The images of a) a top spunbonded polypropylene layer, b) a bottom spunbonded polypropylene layer, and c) a melt blown polypropylene layer.

5. Photographic Image of the CNT Filter-attached Black Mask



Figure S6. Images of the D-CNT filter-laminated black mask used in the hyperthermic antiviral effects test.



The average contact angle value was 131.4° which is almost the same as the water contact angle of the CNT filters with lighter density (131.7°) used in Figure 2b and Figure 4b-d.

Figure S7. Water contact angle measured on D-CNT.

6. Anti-viral Test

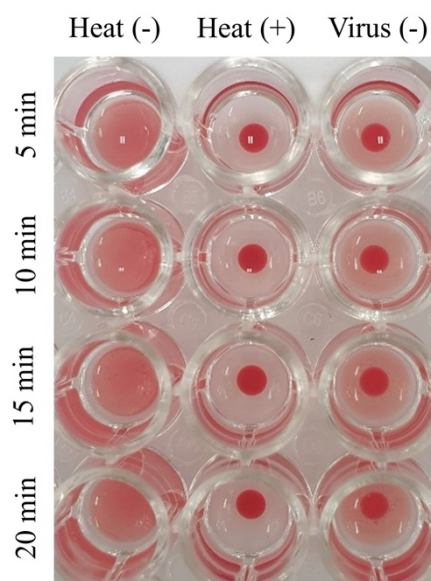


Figure S8. The result image of the HA assay. The active virus with hemagglutinin binds to erythrocyte and agglutinate and it is expressed red and cloudy. In case of inactive virus, it does not agglutinate and blood cells deposit and form red spots. The image shows that all of the virus was completely inactivated due to the heat treatment at 65 °C, as the result of the heat treatment sample and the virus-free group were identical.

7. HCoV-OC43 sampling Image

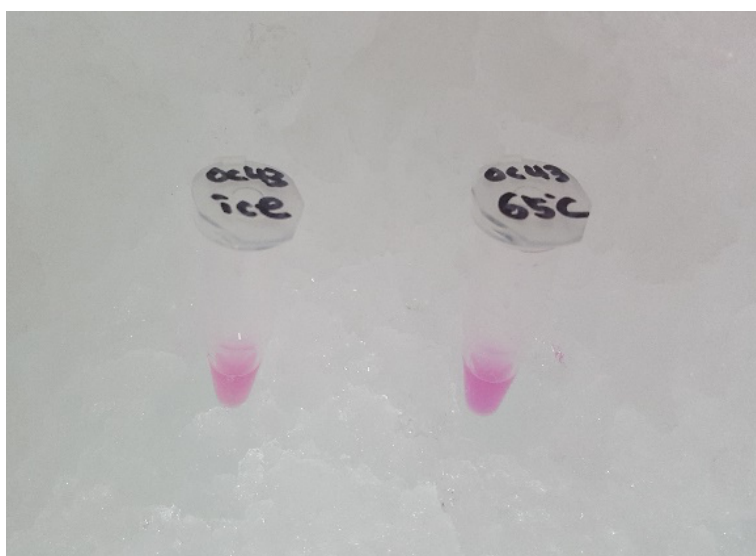


Figure S9. Images of the untreated (left) and heat-treated (right) HCoV-OC43 samples for SEM and TEM measurements.

8. SEM images of human coronavirus OC43

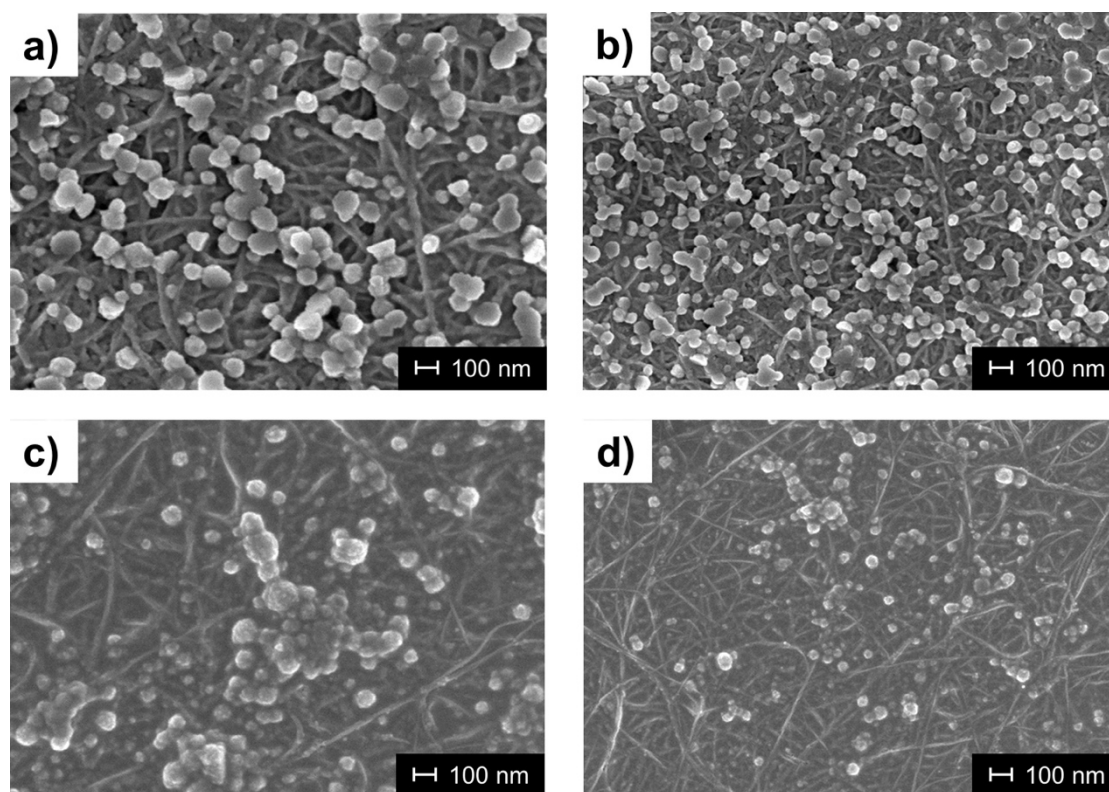


Figure S10. SEM images of a–b) untreated and c–d) heat treated virus at 65 °C throughout 5 mins on the aerosol-synthesized carbon nanotube.

9. TEM images of human coronavirus OC43

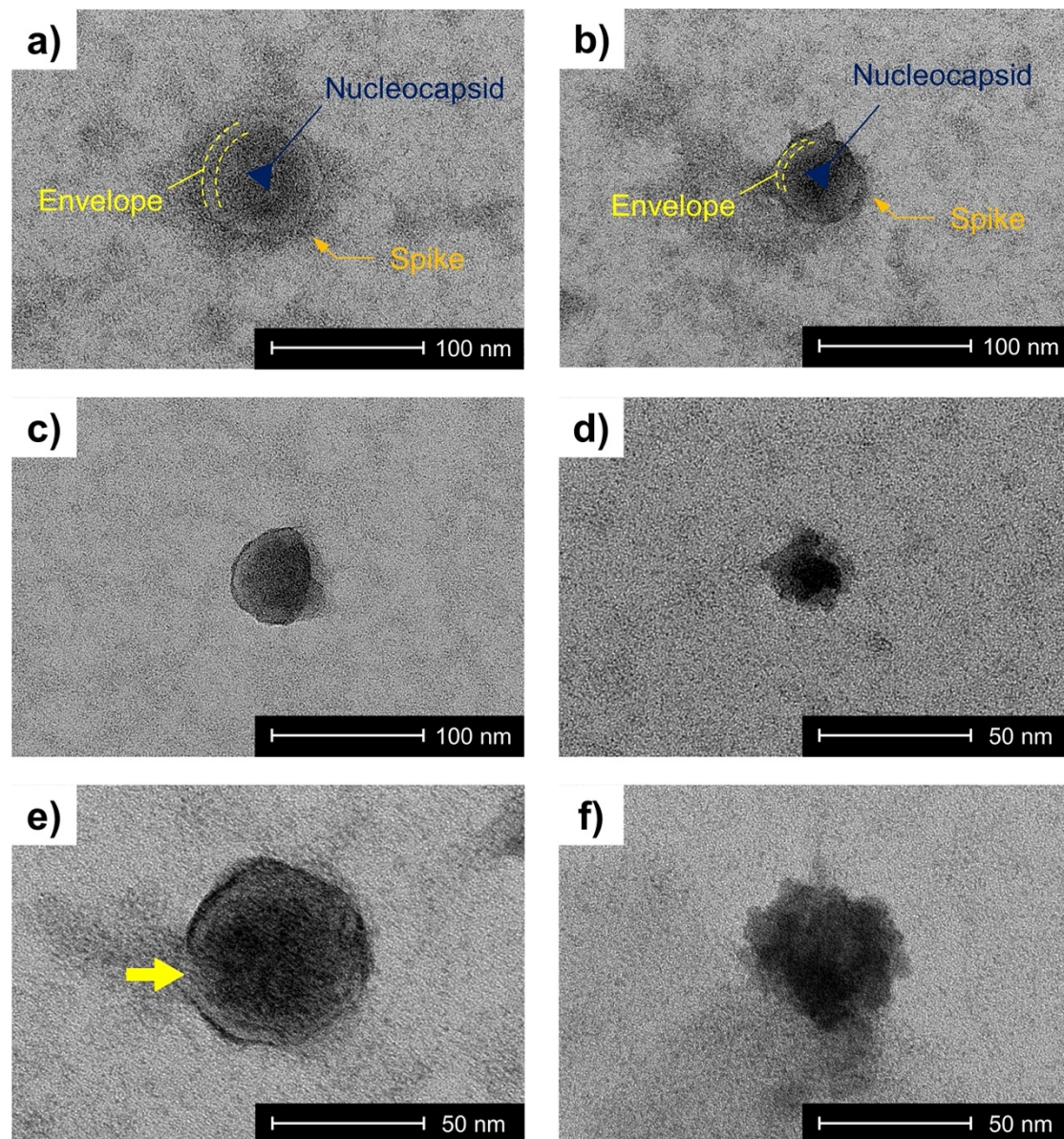


Figure S11. TEM images of a–b) untreated and c–f) heat treated virus at 65 °C throughout 5 mins. While the nucleocapsid, envelop and spike of a virus are clearly seen from untreated virus, denaturing of the envelope (Figure 5g) and shrunk exterior (Figure S8) of the viruses after the heat treatment are seen from heat treated virus images.