## Materials and Methods

**Materials.** Lysine monohydrochloride, hydrochloric acid (HCl), sodium chloride (NaCl), potassium chloride (KCl), magnesium chloride ($MgCl_2$), calcium chloride ($CaCl_2$), and tris(hydroxymethyl)aminomethane (Tris) were purchased from Sigma-Aldrich (St. Louis, MO, USA). Phosphoric acid and acetic acid were purchased from Mallinckrodt Baker (Phillipsburg, NJ, USA). All the chemicals were used without modification. Phosphate buffered saline (PBS; containing 137 mM NaCl, 2.7 mM KCl, 10 mM $Na_2HPO_4$, and 1.8 mM $KH_2PO_4$; pH 7.4) was used to mimic physiological conditions. Milli-Q ultrapure water (18.2 MΩ·cm; EMD Millipore, Billerica, MA, USA) was used in all experiments.

**Cells and viruses.** BHK-21 cells (BCRC#60041) and Vero cells (BCRC#60013) were purchased from the Bioresource Collection and Research Center, Taiwan. Both cells were cultured with Eagle's Minimum Essential Medium (MEM, Gibco, NY, USA) supplemented with 10% fetal bovine serum (FBS, Gibco, NY, USA), at 37 ℃ in an atmosphere of 5% $CO_2$. The BEFV (Tn88128 strain), PRV (PRV-TNL strain), and IBV (M41 strain) were provided by Dr. C.-Y. Chu (National Pingtung University of Science and Technology, Taiwan). The BEFV and PRV were cultured in BHK-21 and Vero cells respectively. The IBV was cultured in specific pathogen-free (SPF) chicken embryos (Animal Health Research Institute, COA, Taiwan) at 37 ℃, relative humidity of 40–70%.

**Table S1.** Product yield, polydispersity index, hydrodynamic diameter, zeta potential, and fluorescence quantum yield (QY) of the as-prepared products from lysine hydrochloride by dry heating.

| | **Product yield (%)**[a] | **PDI**[b] | **Hydrodynamic diameter (nm; *n*=5)** | **Zeta potential (mV; *n*=5)** | **Fluorescence QY (%)**[c] |
|---|---|---|---|---|---|
| CNGs-180 | 96.5 | 0.72 | 506.2 ± 246.6 | 10.3 ± 3.4 | 4.1 |
| CNGs-210 | 89.5 | 0.51 | 313.5 ± 85.6 | 11.2 ± 3.9 | 9.8 |
| CNGs-240 | 80.4 | 0.45 | 156.8 ± 43.2 | 20.1 ± 1.9 | 16.1 |
| CNGs-270 | 61.5 | 0.43 | 122.6 ± 29.9 | 24.9 ± 1.4 | 9.9 |
| CNGs-300 | 20.5 | 0.49 | 278.6 ± 35.5 | 18.9 ± 3.3 | 17.3 |

[a] determined after the purification process by centrifugation of as-prepared products.

[b] polydispersity index (PDI).

[c] compared to quinine sulfate (QY: 54% in 0.1 M $H_2SO_4$).

**Table S2.** Elemental compositions of lysine and the CNGs were obtained by dry heating of lysine hydrochloride at 180, 210, 240, 270, and 300 ℃ for 2 h.

| | **Elemental compositions (wt%)**[a] | | | | |
|---|---|---|---|---|---|
| | **C (%)** | **H (%)** | **O (%)** | **N (%)** | **Cl (%)**[b] |
| Lysine hydrochloride[c] | 38.5 | 8.4 | 18.4 | 15.3 | 19.5 |
| CNGs-180 | 40.1 | 7.2 | 23.7 | 13.7 | 15.3 |
| CNGs-210 | 40.5 | 8.9 | 20.3 | 14.3 | 16.0 |
| CNGs-240 | 42.3 | 7.4 | 15.2 | 16.0 | 19.1 |
| CNGs-270 | 45.5 | 8.2 | 9.3 | 16.6 | 20.4 |
| CNGs-300 | 60.3 | 7.4 | 14.0 | 11.0 | 7.3 |

[a] determined by elemental analysis.

[b] determined by ICP-MS.

[c] theoretical value of lysine hydrochloride ($C_6H_{15}ClN_2O_2$): C (39.5%), H (8.2%), O (17.6%), N (15.4%), and Cl (19.3%).

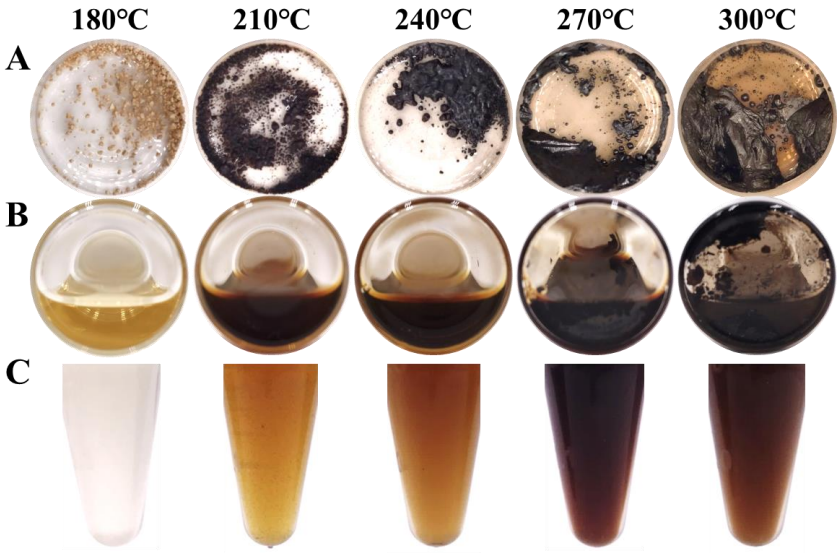



**Figure S1.** Photographs of the as-obtained CNGs. (A) Dry heating (180–300 ℃) of lysine hydrochloride for 2 h, (B) dispersion of the obtained residue in deionized water by sonication for 3 h, and (C) purified CNGs dispersed in deionized water. The CNGs were purified by centrifugation with a relative centrifugation force (RCF) of 5,000 *g* for 60 min to remove aggregated nanoparticles.

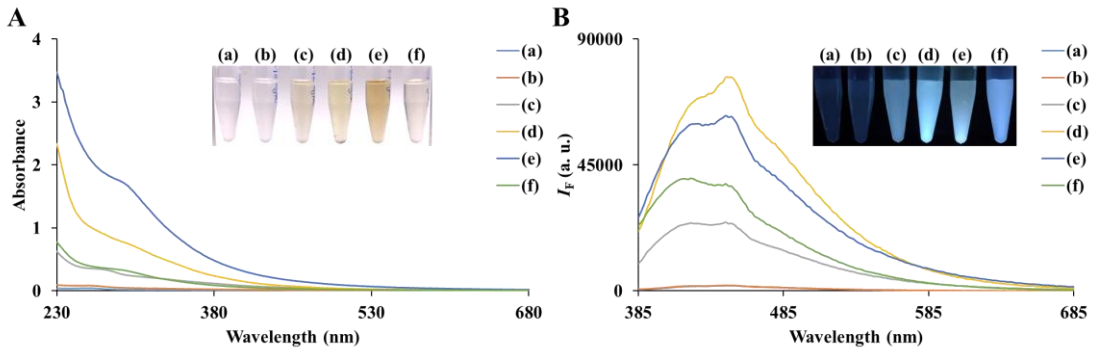
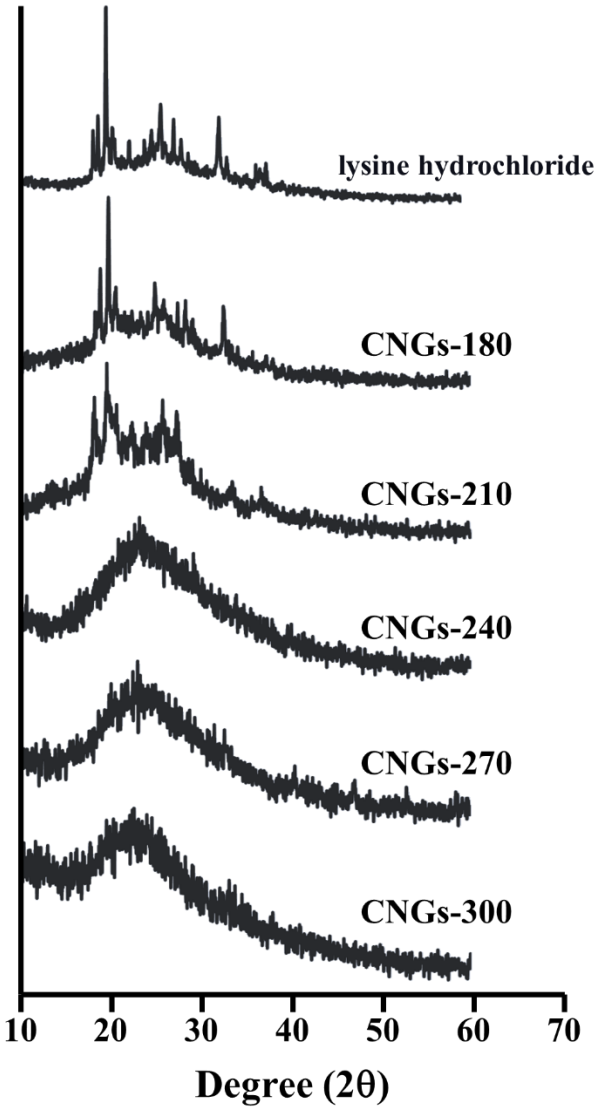
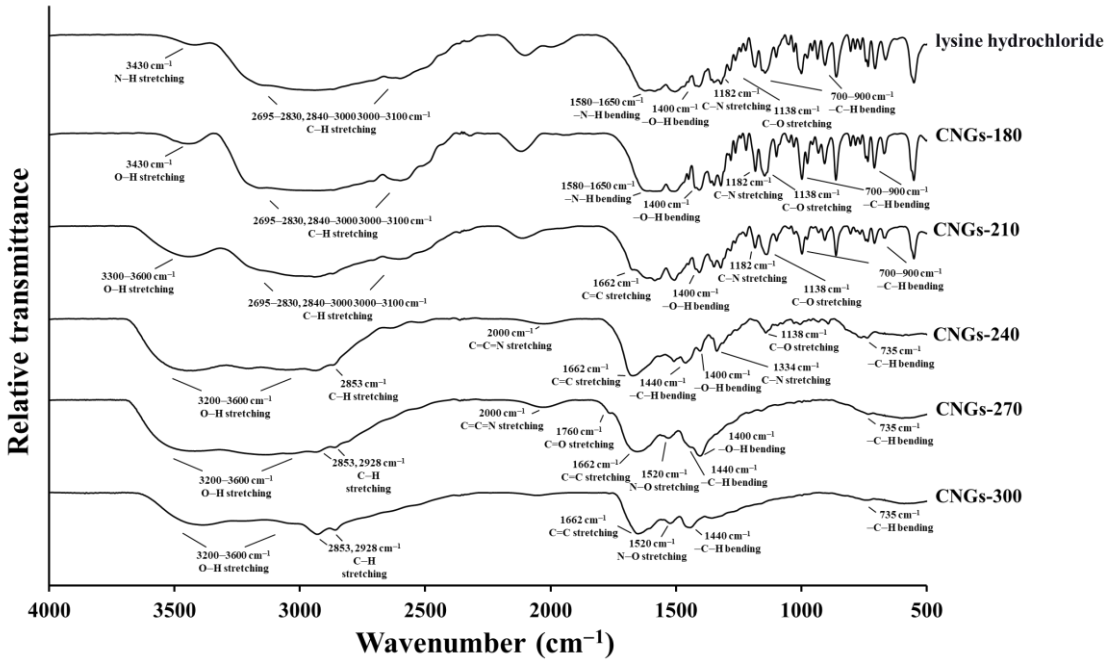


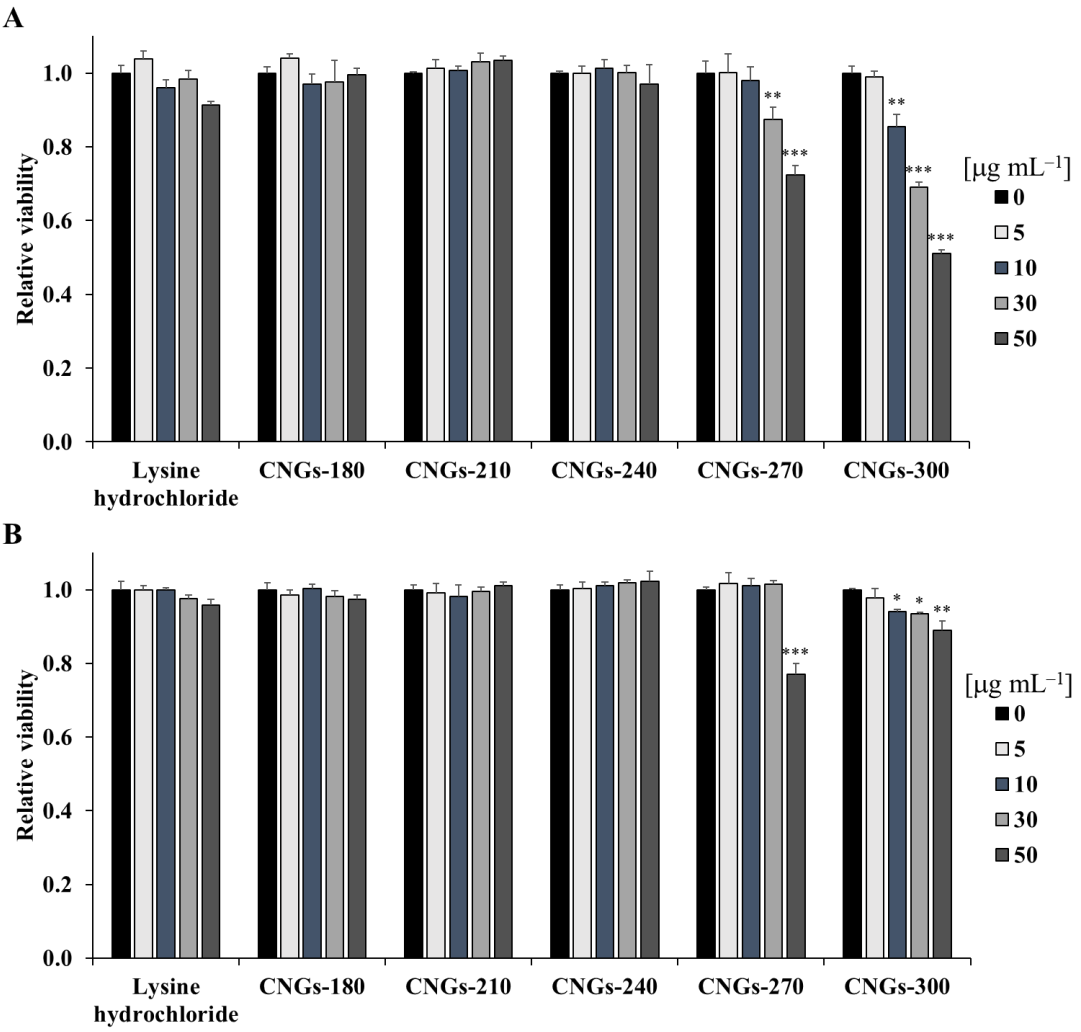

**Figure S2.** (A) UV-vis absorption and (B) fluorescence spectra of CNGs. (a) lysine hydrochloride without heating, (b) CNGs-180, (c) CNGs-210, (d) CNGs-240, (e) CNGs-270, and (f) CNGs-300. All purified samples were 20-fold diluted in 5 mM sodium phosphate buffer (pH 7.4) for measurements. Insets to (A) and (B) are the photographs of the corresponding solutions after 10-fold dilution under visible light and excitation with a UV light of 365 nm. Fluorescence spectra of all samples were recorded at an excitation wavelength of 365 nm. The fluorescence ($I_F$) intensities are plotted in arbitrary units (a. u.).




**Figures S3.** XRD spectra of lysine hydrochloride and CNGs synthesized at 180–300 ℃.




**Figures S4.** FT-IR spectra of lysine hydrochloride and CNGs synthesized at 180–300 ℃.




**Figures S5.** Relative cell viability of (A) BHK-21 cells and (B) Vero cells treated with lysine hydrochloride or CNGs with the concentration of 5 to 50 μg $mL^{-1}$ in media for 30 min followed by replacing the CNGs with fresh media and cultured for 72 h. Error bars represent the standard deviation of four separate experiments. (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ versus cell control).

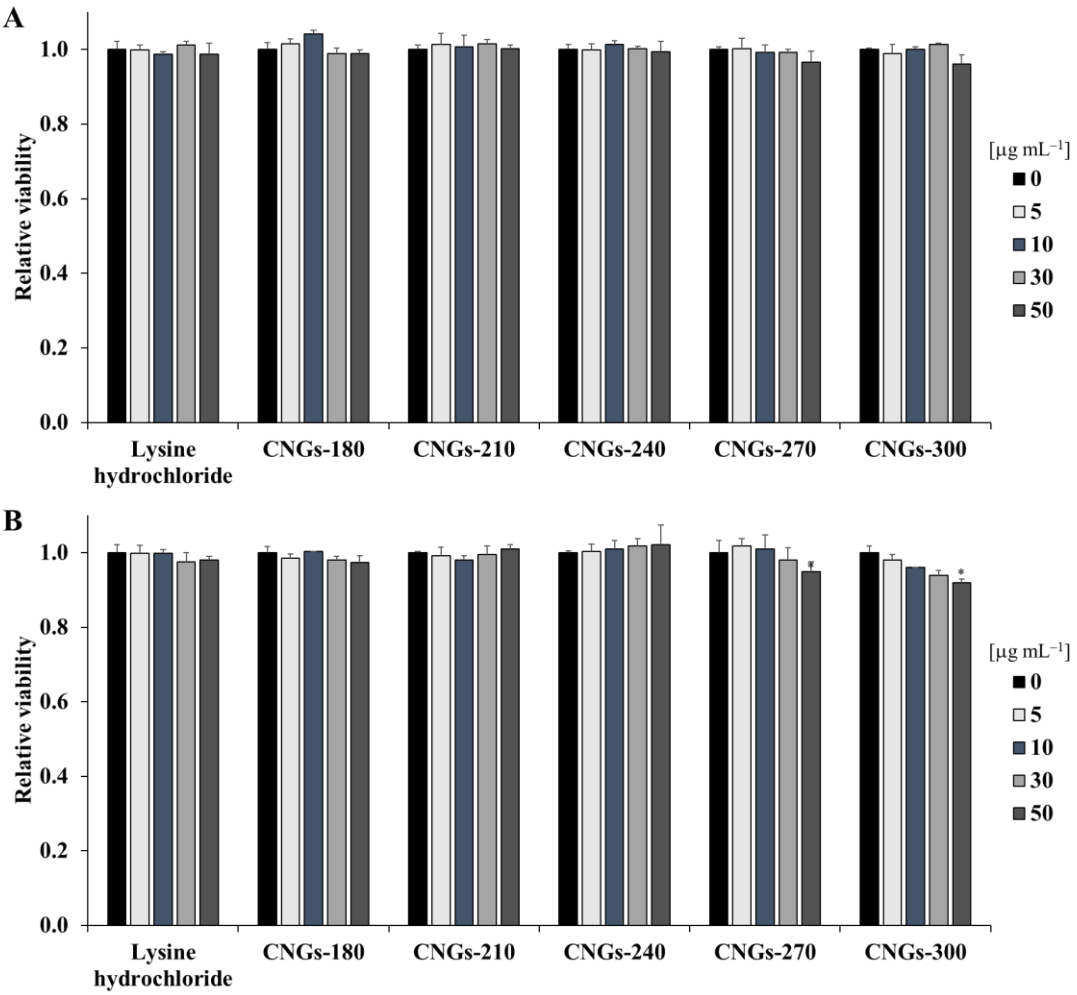



**Figure S6.** Relative cell viability of (A) BHK-21 cells and (B) Vero cells treated with lysine hydrochloride or CNGs with the concentration of 5–50 μg $mL^{-1}$ in media for 24 h. Error bars represent the standard deviation of four separate experiments. (*$p < 0.05$, versus cell control).

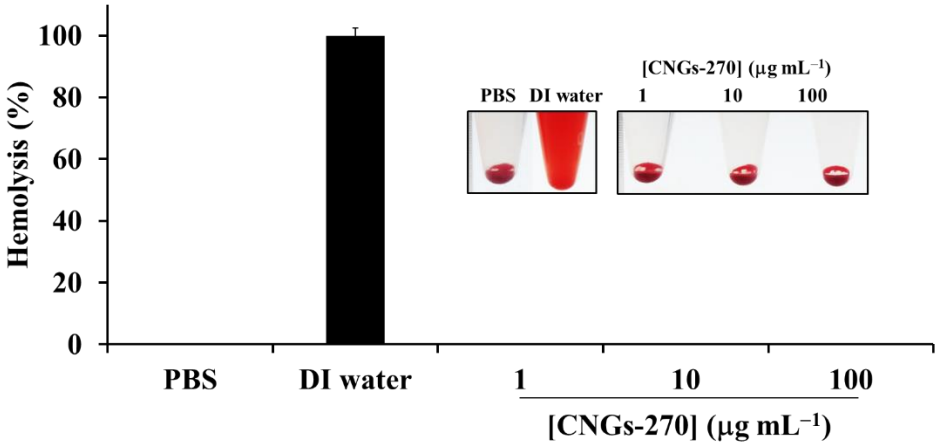



**Figure S7.** Hemolytic activities of CNGs-270 (1–100 μg $mL^{-1}$) on RBCs. Hemolysis assay with PBS and DI water was used as a negative control and positive control, respectively. Error bars represent the standard deviation from three separate experiments.

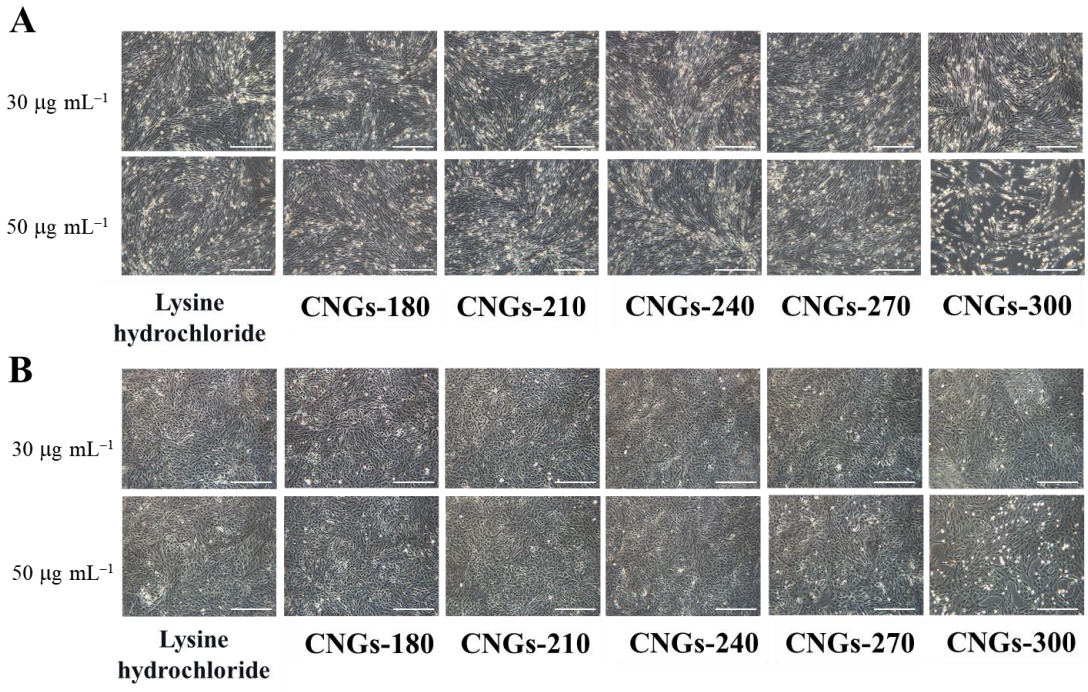



**Figure S8.** Microscopic images of (A) BHK-21 cells and (B) Vero cells treated with lysine hydrochloride or CNGs with a concentration of 30 or 50 μg $mL^{-1}$, followed by replacing fresh medium and cultured for 72 h. The scale bar in the images is 500 μm.

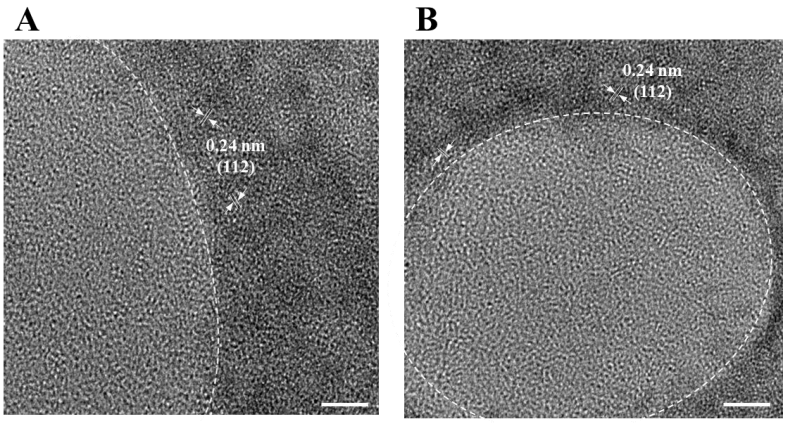



**Figure S9.** HRTEM images of (A) BEFV ($5 \times 10^{5.5}$ $TCID_{50}$ $mL^{-1}$) and (B) PRV ($5 \times 10^{5.5}$ $TCID_{50}$ $mL^{-1}$) after incubation with CNGs-270 (1.0 μg $mL^{-1}$) for 30 min in PBS. The circle region is the virus particle. The scale bar in the HRTEM images is 5 nm.