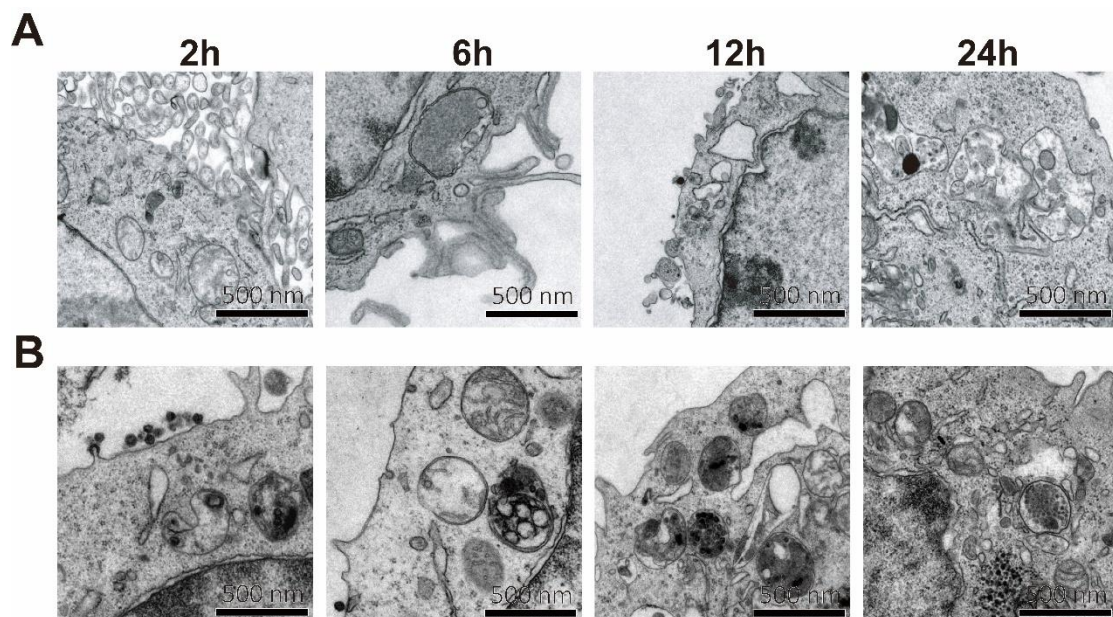


**Figure S1. Epitope engineering strategies for S1 spike and nucleocapsid (N) proteins in virion-mimetic structural vaccines.** (A) Engineering of key mutation sites in S1 mRNA using XBB.1 spike as the genetic backbone. (B) Mutation site design for the nucleocapsid (N) protein. (C) Engineering of key mutation sites in the S1 protein using the Omicron BA.1 spike as the genetic backbone.



**Figure S2 Comparative transfection or infection pathways of virion-mimetic**

particles and SARS-CoV-2 in respiratory epithelial cells. Virion-mimetic particles (A) and SARS-CoV-2 transfection or infection respiratory epithelial cells in different point time of transmission electron microscopy. Scale bars=500 nm.

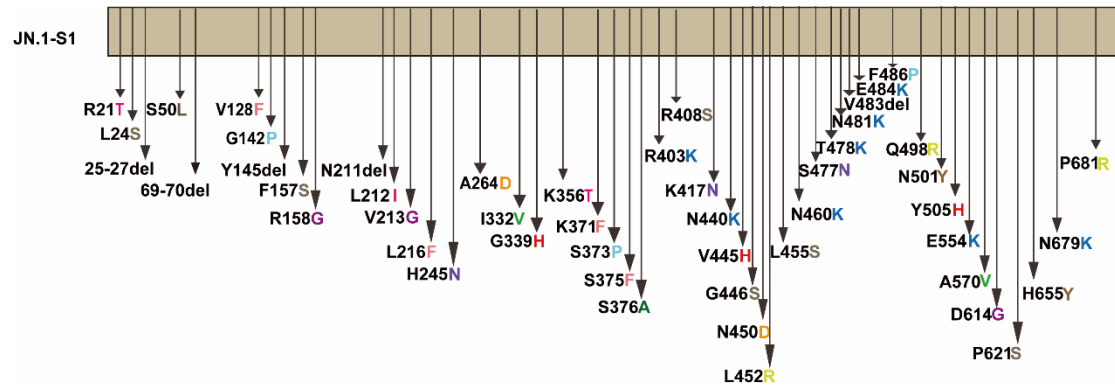


Figure S3. S1 protein amino acid mutation sites in the JN.1 strain.