NanoHack

NanoHack Mask is a last resort device with the purpose of offering protection from airborne particles and prevent spreading liquid contaminating the airways. Published data[1] has shown that the filtration materials used by NanoHack (polypropylene, the same material used in surgical masks) achieves a filtration efficiency of 96.4% for microorganisms of 1 micron and 89.5% for microorganisms of 0.02 microns[1].

According to the U.S. Food and Drug Administration (FDA), the design of surgical masks do not allowed a complete protection from germs and other contaminants due to their loose fit[2]. In addition, surgical masks are single-used devices required to be safely disposed. The Centers for Disease Control and Prevention (CDC) recommends placing these items it in a plastic bag and put it in the trash, then wash your hands after handling the used mask[2]. Previous published research[3] has indicated that the high viral load remaining in surgical masks and respirators, can be a source of viral transmission both to the person wearing the mask or respirators and to others[3]. This may happen when healthcare workers touch their mask and then fail to wash their hands properly or when they dispose of the mask without proper safe disposal precautions[3]. In addition, pathogens shedding from surgical respirators onto patients in the operating room, increasing the risk of nosocomial infections[3]. Thus, NanoHack Mask uses a recyclable and biocompatible polymer containing a copper nanocomposite that has shown antimicrobial properties and capable of deactivate viruses.

3D Printing Specifications

Our printing specifications will result in fused layers, stopping even water molecules that are 0.000282 µm. In general, the minimum wall thickness that we recommend is 1.7 mm. This minimum wall thickness will result in three extrusions side by side producing a double seal. In addition, we recommend adjusting the slicer settings over extrude. By decreasing the print speed and increasing the extrusion multiplier. The specific settings for the slicer software are as follows:

- *Layers*: Layer height- .2mm, First layer height:0.25mm, Perimeters:2, Avoid crossing perimeters: X, Eternal Perimeters first: X, Start end overlap: 140%, Merge overlapping lines: X, Expand thin walls: X, Top solid layers: 9, Bottom solid layers: 9, Infill Fill density: 100%, Infill type: lines starting angle: 0, Infill overlap: 0.9mm, Fill thin gaps: X, Speed infill: 20mm/s, Top solid infill: 20mm/s, raft: 100%, inside perimeters: 20mm/s, outside perimeters: 20mm/s, Support material: 20mm/s, bridges: 25mm/s, Travel: 130mm/s, First layer speed: 20mm/s
- *Filament:* PLACTIVE™: 1.75mm
- *Temperatures*: Extruder temperature: 233 Deg C°, Extruder wipe temperature: 0 Deg C°
- *Retraction*: Speed: 70mm/s
- *Extrusion*: Extrusion multiplier: 1.5, First layer: 160%, Outside perimeters: 160%
- *Printer*: Any desktop 3D printer that allows these settings

References

1. Anna Davies, et al. Testing the Efficacy of Homemade Masks: Would They Protect in an Influenza Pandemic? Disaster Medicine and Public Health Preparedness, Available on CJO 2013 doi:10.1017/dmp.2013.43
2. Food and Drug Administration (FDA): https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/n95-respirators-and-surgical-masks-face-masks. Accessed March 20, 2020
3. Borkow G, etal., (2010) A Novel Anti-Influenza Copper Oxide Containing Respiratory Face Mask. PLoS ONE 5(6): e11295. doi:10.1371/journal.pone.0011295.