Supporting Information

Evaluating Layer Contributions and Salt Coating Effects on Mask Performance

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Table S1. Summary of breath resistance and filtration efficiency standards for respirators and masks

Category	Country	Agency	Standard	N95, FFP2, KN95, KF94		Surgical, medical masks	
				Inhalation	Exhalation	Breath resistance	Surface area
Breath resistance	USA	National Institute for Occupational Safety and Health (NIOSH)	NIOSH 42 CFR 84[1]	343 Pa (85 L/min)	245 Pa (85 L/min)	-	Whole mask
		American Society for Testing and Materials (ASTM)	ASTM F2100-19e1[2]	-	-	50/60/60 Pa/cm^2 (8 L/min)	4.9 cm^2
	Canada	Canadian Standards Association (CSA)	CSA Z94.4.1:21[3]	100/175/343 Pa (85 L/min)	100/175/245 Pa (85 L/min)	-	Whole mask
	EU	European Committee for Standardization (CEN)	EN 149[4]	240 Pa (90 L/min) & 70 Pa (30 L/min)	300 Pa (160 L/min)		Whole mask
			EN 14683[5]	-	-	40/40/60 Pa/cm^2 (8 L/min)	4.9 cm^2
	China	Standardization Administration of the People's Republic of China (SAC)	GB 2626-2006[6]	350 Pa (85 L/min)	250 Pa (85 L/min)	-	Whole mask
		China Food and Drug Administration (CFDA)	YY 0469-2011[7]	-	-	49 Pa/cm^2 (8 L/min)	4.9 cm^2
	Korea	Ministry of Food and Drug Safety (MFDS)	Notice of MFDS 2020-6[8]	70 Pa (30 L/min)	-	-	Whole mask

Category	Country	Agency	Standard	Particles	Size	Flow rate	Filtration efficiency	Sample type
Particulate Filtration efficiency (PFE)	USA	NIOSH	NIOSH 42CFR84[1]	NaCl	0.3 µm polydisperse	85 L/min	95/99/99.97%	Respirators
				Dioctyl phthalate	0.3 µm polydisperse	85 L/min	95/99/99.97%	Respirators
		ASTM	ASTM F2100-19e1[2]	Polystyrene latex (PSL) microspheres	0.1 µm monodisperse	28.3 L/min	95/98/98%	Surgical masks
	EU	CEN	EN 149[4]	NaCl	0.6 µm polydisperse	95 L/min	80/94/99%	Respirators
				Paraffin oil	0.6 µm polydisperse	95 L/min	80/94/99%	Respirators
	China	SAC	GB 2626-2006[6]	NaCl	0.3 µm polydisperse	85 L/min	90/95/99.97%	Respirators
				Paraffin oil, dioctyl phthalate	0.3 µm polydisperse	85 L/min	90/95/99.97%	Respirators
	Korea	MFDS	Notice of MFDS 2020-6[8]	NaCl	0.6 µm polydisperse	95 L/min	80/94/99%	Respirators
				Paraffin oil	0.4 µm polydisperse	95 L/min	80/94/99%	Respirators
Bacterial filtration efficiency (BFE)	USA	ASTM	ASTM F2101 and ASTM F2100[2, 9]	*Staphylococcus aureus*	3.0 ± 0.3 µm mean particle size (MPS)	28.3 L/min	95/98/98%	Surgical masks
	EU	CEN	EN 14683[5]	*Staphylococcus aureus*	3.0 ± 0.3 µm MPS	28.3 L/min	95/98/98%	Surgical masks
	China	CFDA	YY 0469-2011[7]	*Staphylococcus aureus*	3.0 ± 0.3 µm MPS	28.3 L/min	≥ 95%	Surgical masks

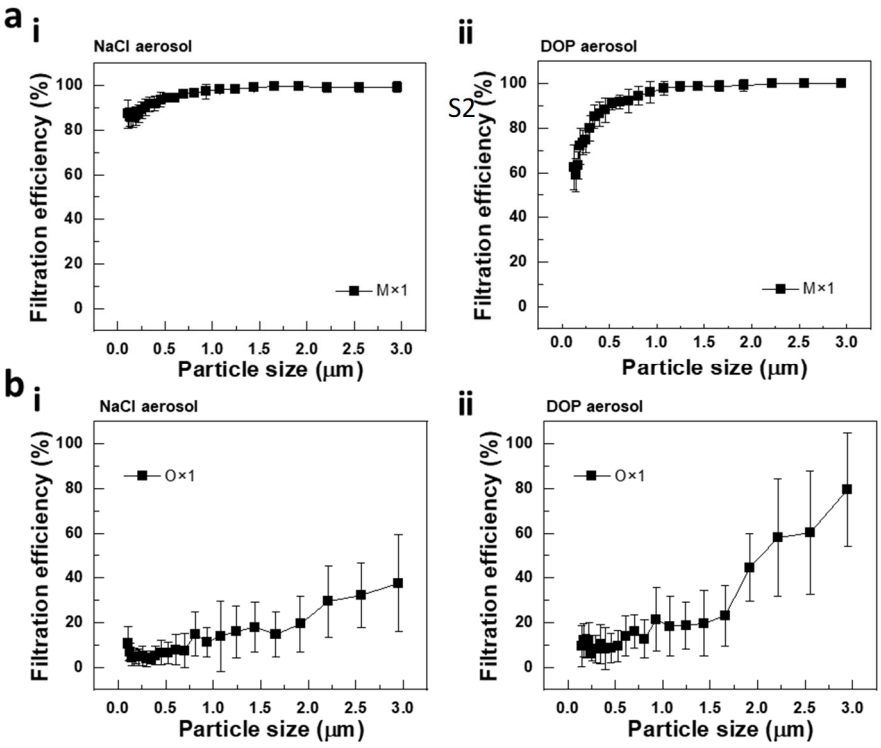

Figure S1. Particle size-dependent filtration efficiency of single bare fabrics. (a,b) 5% NaCl aerosol (i) and DOP aerosol (ii) used to measure the filtration efficiency of fabrics: (a) M×1 and (b) O×1. (n = 7–15 for a and n = 9–19 for b, mean ± SD)).

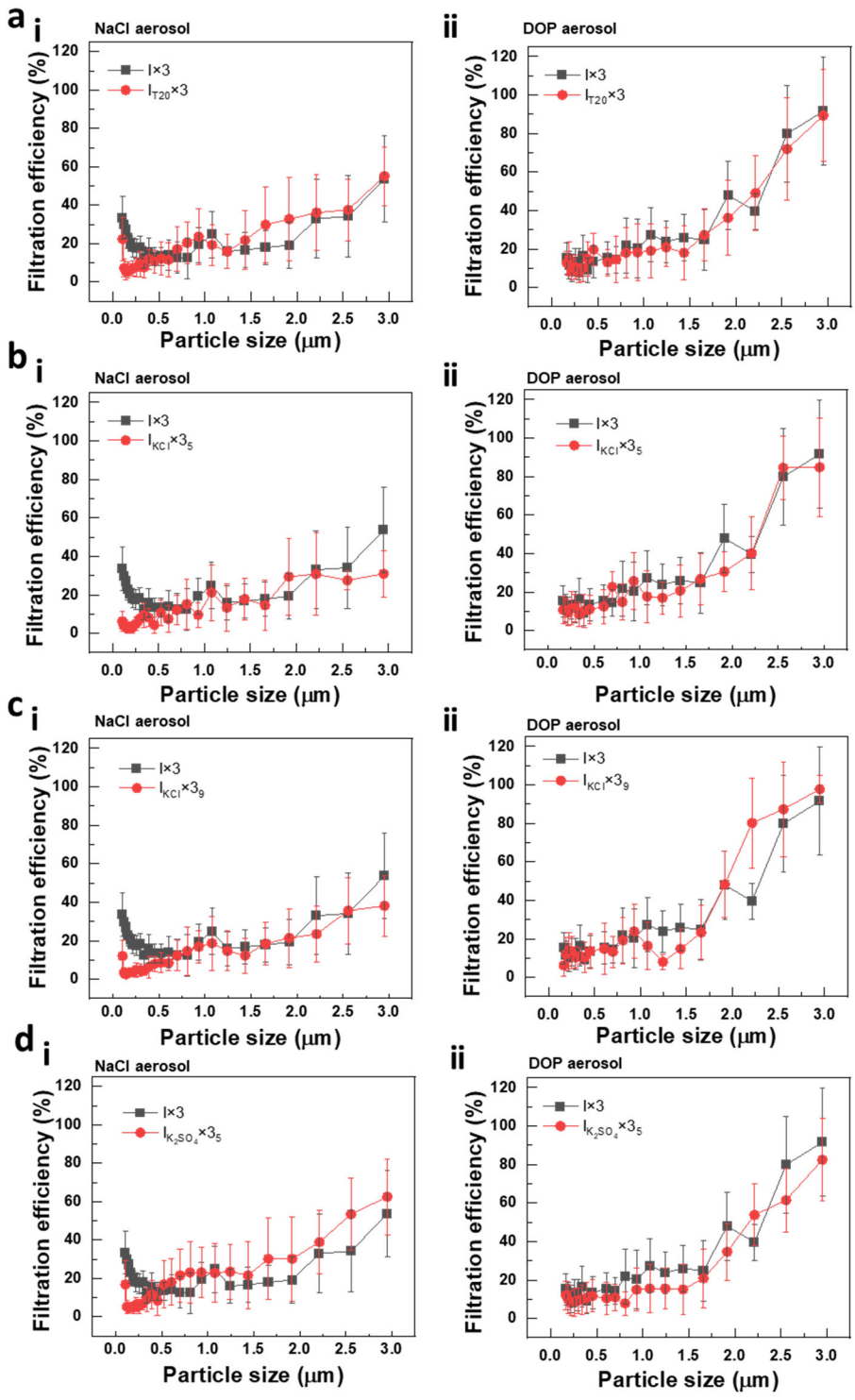

Figure S2. Particle size-dependent filtration efficiency of salt-coated fabric only conditions tested. (a) I_{T20}×3 (n = 6–24, mean ± SD), (b) I_{KCl}×3_5 (n = 7–24, mean ± SD), (c) I_{KCl}×3_9 (n = 7–24, mean ± SD), and (d) I_{K2SO4}×3_5 (n = 7–24, mean ± SD): 5% NaCl aerosol (i) and DOP aerosol (ii).

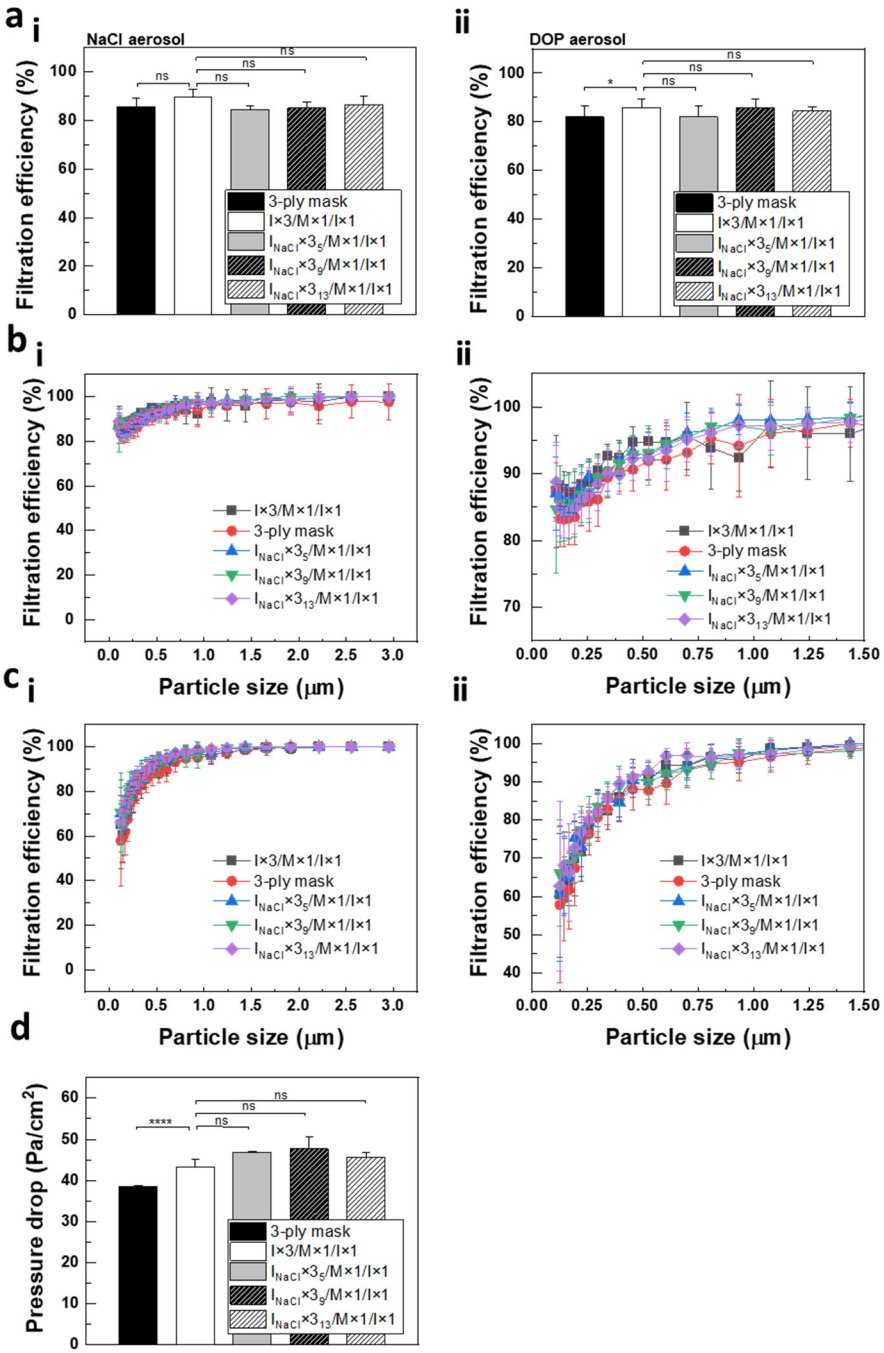

Figure S3. Filter performance of bare and salt-coated fabrics with different staking sequences. Filtration efficiency and breathability were performed according to NIOSH 42CFR84 and ASTM F2100-19e1 standards, respectively. (a) Overall filtration efficiency of I×3 and I_{NaCl}×3 as an outer of the 3-ply mask (i: 5% NaCl aerosol and ii: DOP aerosol). (n = 12–19 for a(i) and n = 11–16 for a(ii), mean ± SD) (b,c) Particle size-dependent filtration efficiency of I×3 and I_{NaCl} ×3 as an outer of the 3-ply mask, tested with 5% NaCl aerosol (b) and DOP aerosol (c) (i: filtration efficiency of stacked fabrics and ii: zoomed-in filtration efficiency of the stacked fabrics). (n = 12–19 for b and n = 7–16 for c, mean ± SD). (d) Breathability of I×3 and I_{NaCl} ×3 used as an outer. (n = 9–12, mean ± SD).

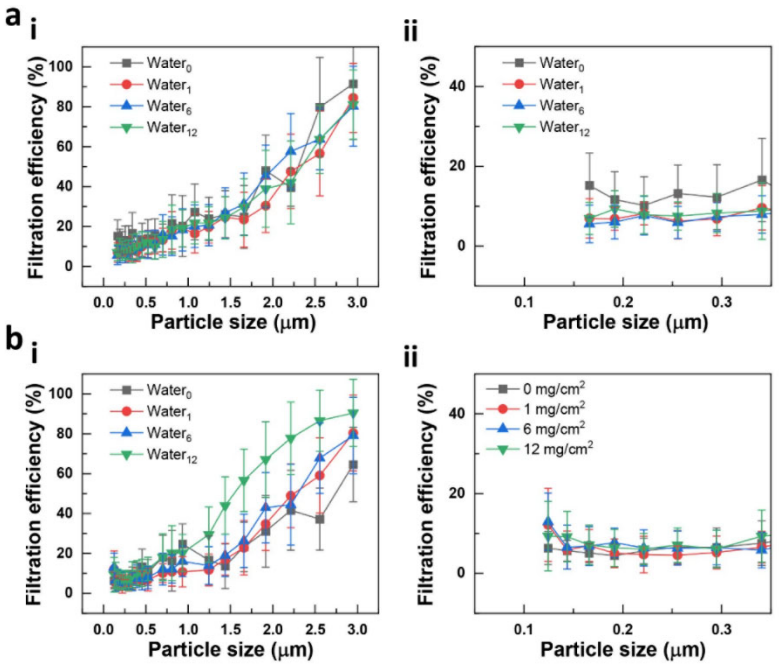

Figure S4. Particle size-dependent filtration efficiency of I×3 (a) and $I_{NaCl}\times3_9$ (b) tested with DOP aerosols (i: filtration efficiency of fabrics and ii: zoomed–in filtration efficiency of the fabrics).

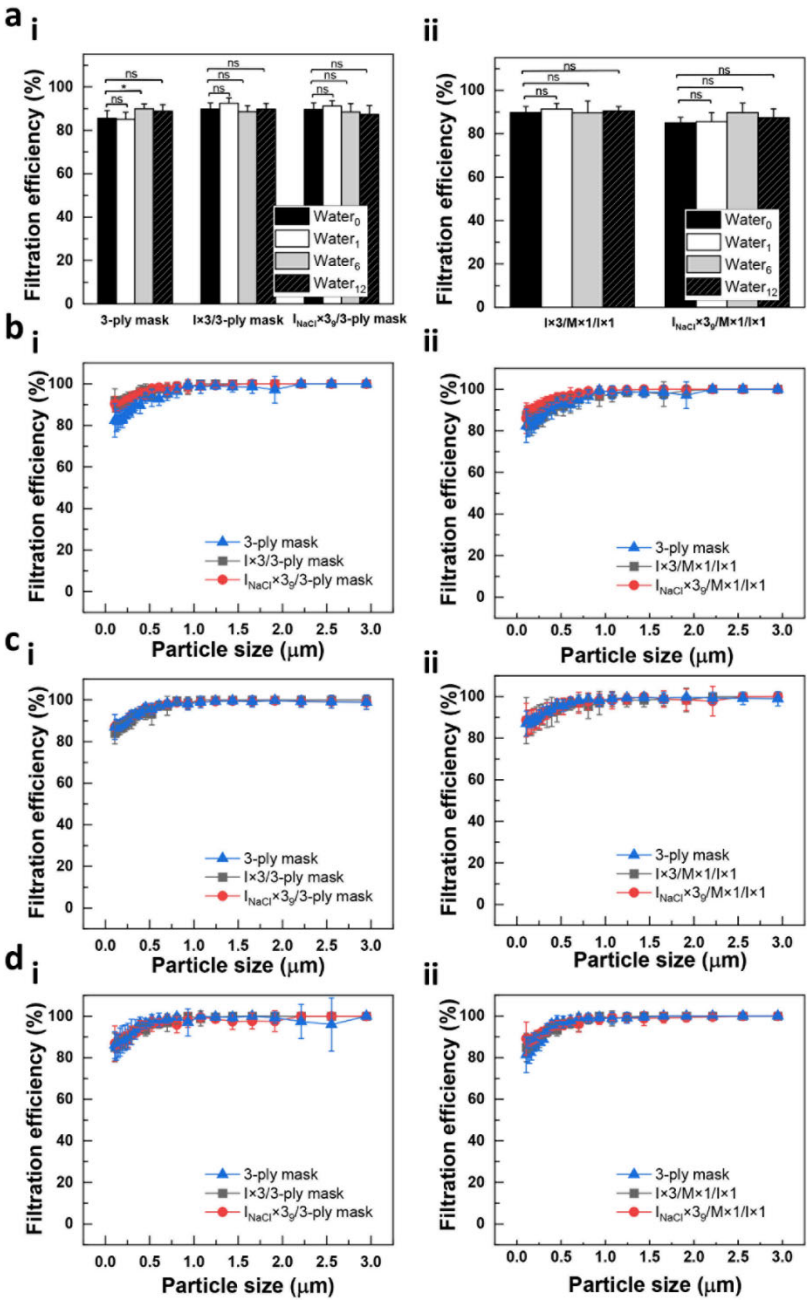

Figure S5. Filtration efficiency of wet I×3 and I_{NaCl} ×3 as a cover and an outer layer of the 3-ply mask, tested with 5% NaCl aerosol according to NIOSH 42CFR84. (a–d) I×3 and $I_{NaCl}×3_9$ fabrics used as a cover (i) and an outer layer (ii): (a) overall filtration efficiency (n = 9–20, mean ± SD), (b) 1 mg/cm^2 of water (n = 10–13, mean ± SD), (c) 6 mg/cm^2 of water (n = 9–13, mean ± SD), and (d) 12 mg/cm^2 of water (n = 10–11, mean ± SD). For all panels: ns, $P > 0.05$; *, $P < 0.05$, by GLM.

References

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