Supplementary Information

Transparent and Flexible MXene-Chitosan Nanocomposite Film as Effective UV and High-Energy Blue Light Shielding Applications

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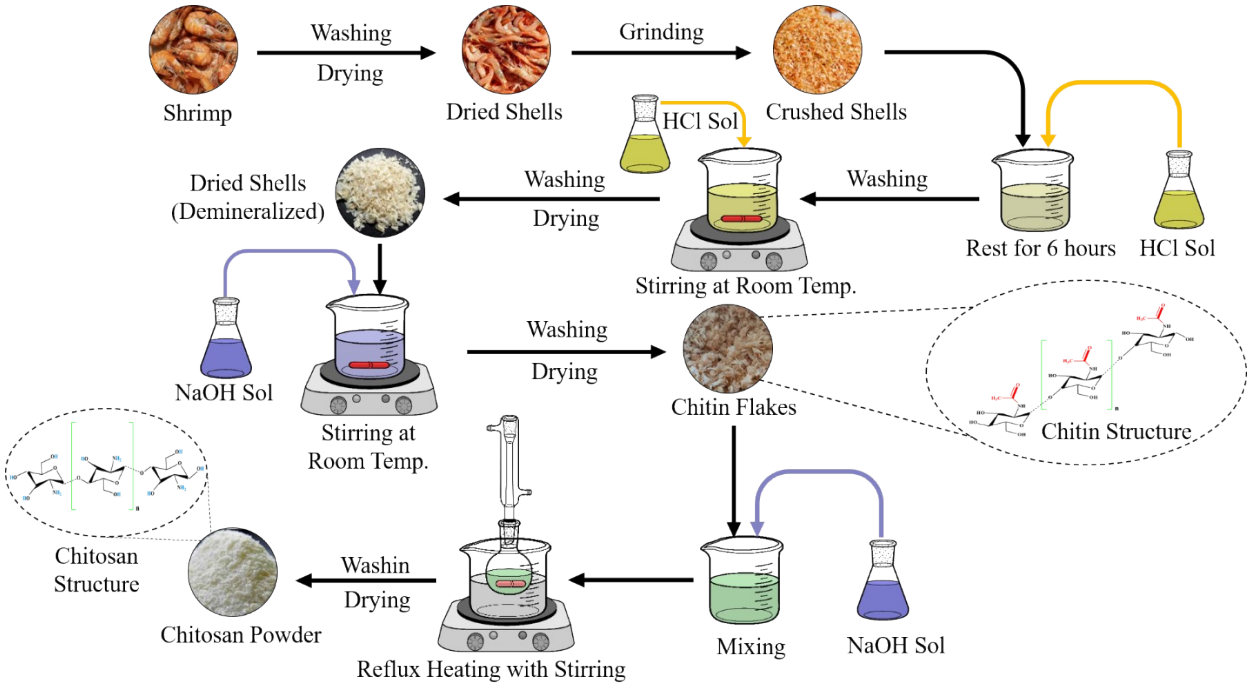

Figure S1. The Production of CS from Shrimp Shell by Chemical Synthesis

Table S1. Thickness of CS and CMX films at five sites for each film.

Samples	Left side	Right side	Up side	Down side	Center	Overall Thickness
CS	0.009	0.011	0.01	0.013	0.009	0.0104 ± 0.001
CMX-0.005	0.011	0.014	0.012	0.012	0.012	0.0122 ± 0.001
CMX-0.01	0.013	0.015	0.013	0.014	0.014	0.0138 ± 0.0008
CMX-0.02	0.011	0.014	0.012	0.015	0.011	0.0126 ± 0.002
CMX-0.04	0.012	0.015	0.016	0.015	0.013	0.0144 ± 0.002

*Values are given as mean ± standard deviation

Table S2. The ATR-FTIR spectra of the synthesized CS, MXene and CMX films.

CS	
3430	Stretching vibration of – OH, $–NH_2$ group
1656	Vibrations of carbonyl group (amide band I)
1590	Presence of amide band II ($–NH_2$ bending)
2884 & 1430	Presence $–CH_2$ groups' in CH_2OH
1340	$–CH_3$ group of $NHCOCH_3$ (Amide III)
1150	Oxygen stretching of glycosidic linkage
1082 & 1023	Skeletal vibrations involving the C-O stretching
908	Pyranose ring
1430 to 492	Presence of CH_3, CH_2, CH groups, primary and secondary -OH groups; attached to the pyranose ring
MXene	
3385	Stretching vibration of –OH
1680 & 1608	Stretching vibration C=O
590	Stretching vibration Ti-O
1420	Bending vibration –OH
1140	Stretching vibration C-F
1048	Stretching vibration of C–O
745	Bending vibration Ti-F
CMX	
3352	Stretching vibration of –OH
1652	Stretching vibration of C=O & –O group
550	–F group
1560	N–H bending vibration bands
1020	–C–O bending vibration

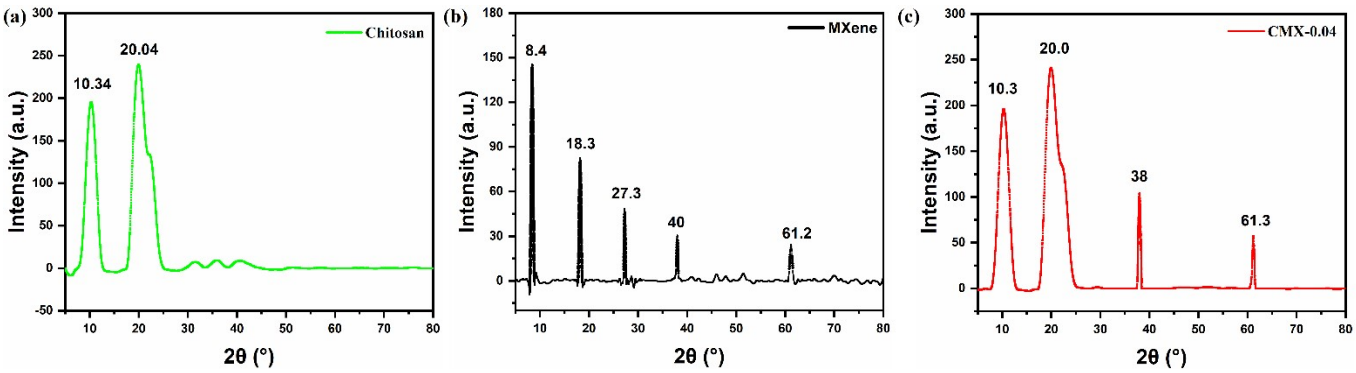

Figure S2. XRD spectrum of pure CS, MXene powder and CMX-0.04 film.

Table S3. The Transmittance and Blocking data of synthesized CS, and CMX films.

Transmittance (%)						
T%	**200-280 (UV-C)**	**280-315 (UV-B)**	**315-400 (UV-A)**	**400-450 HEBL**	**450-800**	**450-900**
CS	53.21	72.63	83.49	89.16	90.66	90.85
CMX-0.005	22.99	34.20	49.74	60.44	67.12	67.73
CMX-0.01	2.36	5.14	18.61	31.66	43.83	45.08
CMX-0.02	0.34	0.66	6.25	14.86	29.67	31.73
CMX-0.04	0	0	0.45	2.52	14.46	16.90
Blocking (%)						
B%	**200-280 (UV-C)**	**280-315 (UV-B)**	**315-400 (UV-A)**	**400-450 HEBL**	**450-800**	**450-900**
CS	46.79	27.37	16.51	10.84	9.34	9.15
CMX-0.005	77.01	65.80	50.26	39.56	32.88	32.27
CMX-0.01	97.64	94.86	81.39	68.34	56.17	54.92
CMX-0.02	99.66	99.34	93.75	85.14	70.33	68.27
CMX-0.04	100.00	100.00	99.55	97.48	85.54	83.10

Table S4. Initial weight of films (M_i), Final weight of dried films (M_f) after 105° C, Moisture content (MC%), Wet (W_{wet}) and Dry (W_{dry}) samples, Swelling Index (W%), and initial dry weight ($^{W}{}_{i}$), final dry weight ($^{W}{}_{f}$) at 105 °C for 24 h Solubility (WS%) of the Prepared Films.

Samples	**M_i**	**M_f**	**MC (%)**	**W_{dry}**	**W_{wet}**	**%W (%)**	**M_f/W_i**	**W_f**	**%WS (%)**
CS	4.4	3.4	22.73	4.40	5.7	29.55	3.4	3.0	11.76
CMX-0.005	4.4	3.5	20.45	4.50	5.1	13.33	3.5	3.2	8.57
CMX-0.01	4.3	3.5	18.60	4.35	4.9	12.64	3.5	3.3	5.71
CMX-0.02	3.8	3.4	10.53	3.85	4.3	11.69	3.4	3.2	5.88
CMX-0.04	4.7	4.3	8.51	4.70	5.1	8.51	4.3	4.2	2.32

Table S5. Moisture content (**MC)**, Swelling Index (**%W)**, and Solubility (**%WS)** of the Prepared Films.

Films	**MXene Content**	**MC (%)**	**%WS (%)**	**%W (%)**
CS	0	22.73	11.76	29.55
CMX-0.005	0.005	20.45	8.57	13.33
CMX-0.01	0.01	18.6	5.71	12.64
CMX-0.02	0.02	10.53	5.88	11.69
CMX-0.04	0.04	8.51	2.32	8.51

Table S6. Different properties of films obtained from TGA analysis

	Pure CS	**CMX-0.04**
Temperature at which 5% weight loss (T_{onset})	65.4	87
Temperature at which 50% weight loss (T_{50})	444	495
Temperature at which maximum weight loss (T_{MAX})	485	524
	Weight loss (%)	
First stage (RT to 210 °C)	10.76%	7.4%
Second stage (210 °C to 410 °C)	36.04%	34.74%
Third stage (above 410 °C)	42.47%	39.56%
Residual char %	7.4%	17.6%