

Electronic Supplementary Information Sheet

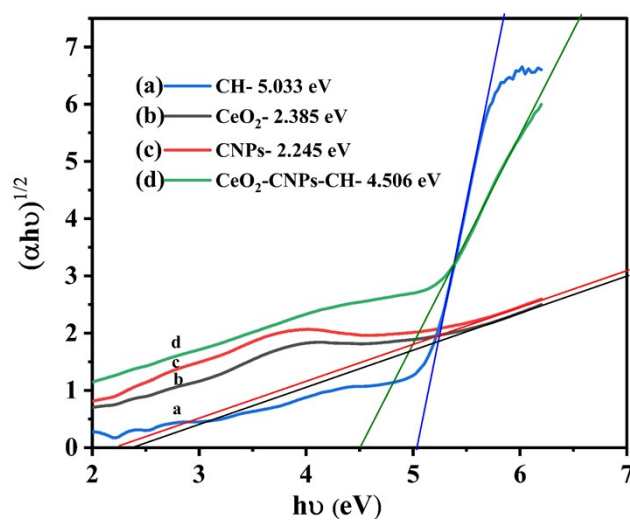


Fig. S-1. Band gaps in terms of the Tauc plot of $(\alpha h\nu)^{1/2}$ versus $(h\nu)$

Table S-1. Data for crystallite size of CeO₂.

Samples	K	$\lambda(\text{\AA})$	2θ	β (Degree s) FWHM	$4\sin \theta$	$\beta \cos \theta$	$\frac{1}{\ln \cos \theta}$	$\ln \beta$
CeO ₂	0.94	1.5406	28.759	1.456	0.9934	0.02462	0.03183	-3.6719
			33.260	1.535	1.1447	0.02567	0.04272	-3.6195
			47.776	1.678	1.6198	0.02678	0.08955	-3.5302
			56.708	1.719	1.8996	0.02640	0.12780	-3.5064

Table S-2. Crystallite size from Scherrer and Modified Scherrer equation

Samples	Calcination (°C)	Debye–Scherrer equation size (in nm)	Modified Scherrer equation size (in nm)
CeO ₂	450	5.36	5.88

Table S-3. Crystallite size from Williamson-Hall plot, micro-strain, and dislocation density.

Samples	Calcination (°C)	Williamson Hall plot size (in nm)	Micro strain (e)	Dislocation Density (δ)
CeO ₂	450°C	6.26	0.194	3.475

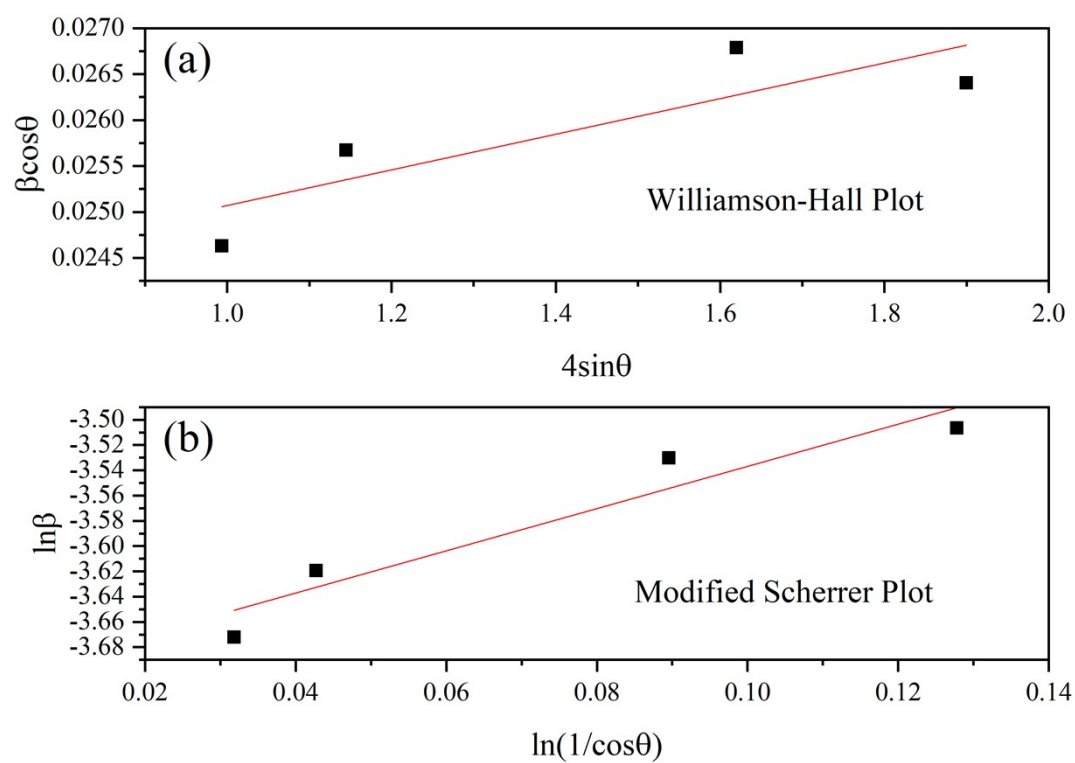


Fig. S-2. Williamson-Hall plot and Modified Scherrer plot for the calculation of crystallite size.

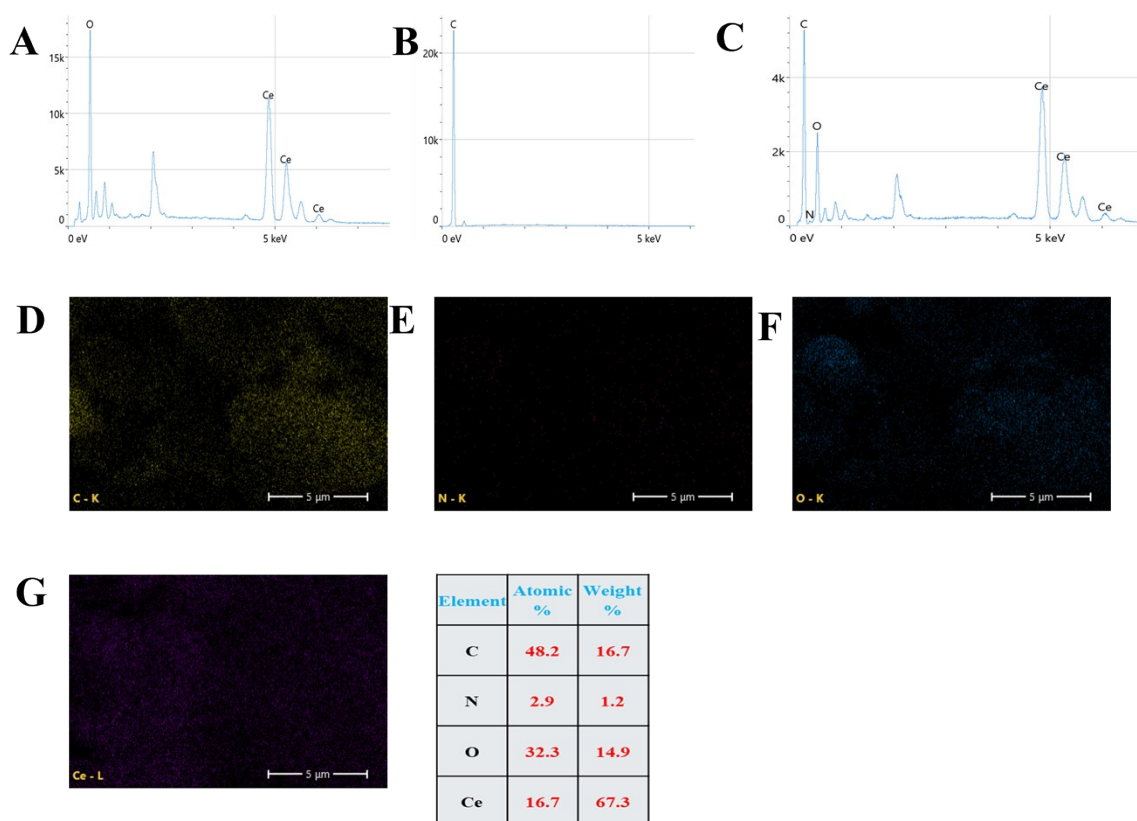


Fig. S-3. EDS analysis of (A) CeO_2 (B) CNPs (C) CeO_2 -CNPs-Ch nanocomposite, Elemental mapping (D-G) of CeO_2 -CNPs-Ch nanocomposite with elemental distribution in terms of weight and atomic%.

Table S-4. The Surface element analysis of CeO_2 , CNPs, and CeO_2 -CNPs-Ch nanocomposite.

Element	CeO_2		CNPs		CeO_2 -CNPs-Ch nanocomposite	
	(wt.%)	(at%)	(wt.%)	(at%)	(wt.%)	(at%)
O	25.4	74.9	-----	-----	14.9	32.3
Ce	74.6	25.1	-----	-----	67.3	16.7
C	-----	-----	100	100	16.7	48.2
N	-----	-----	-----	-----	1.2	2.9

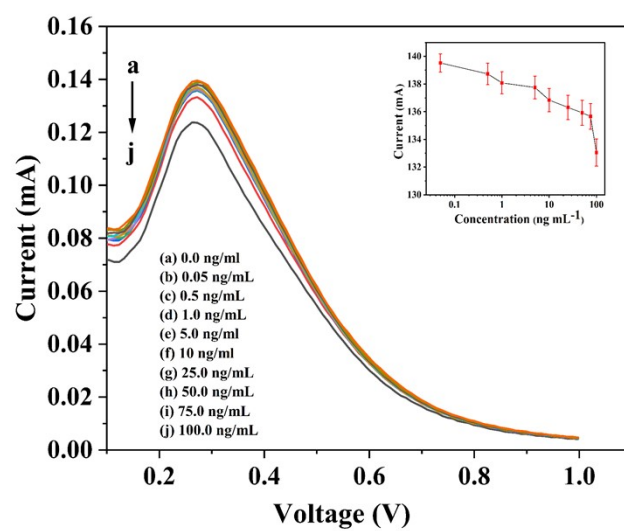


Fig. S-4. DPV of the anti-CEA/CeO₂-Ch/ITO with CEA concentration (0.05 to 100 ng mL⁻¹) and peak current variation with the logarithm of CEA concentration (inset).

Table S-5A. Repeatability data of anti-CEA/CeO₂-CNPs-Ch/ITO immunoelectrode with low CEA concentration (0.05 ng mL⁻¹)

Electrodes	Repetition of DPV response	Mean value (μA)	% RSD
Electrode 1	10 times	244.93	1.51
Electrode 2	10 times	245.64	1.41
Electrode 3	10 times	245.70	0.79
Electrode 4	10 times	244.67	1.18
Electrode 5	10 times	246.66	0.31

Table S-5B. Repeatability data of anti-CEA/CeO₂-CNPs-Ch/ITO immunoelectrode with medium CEA concentration (10 ng mL⁻¹)

Electrodes	Repetition of DPV response	Mean value (μA)	% RSD
Electrode 1	10 times	237.87	2.94
Electrode 2	10 times	237.01	1.41
Electrode 3	10 times	237.56	1.93
Electrode 4	10 times	232.84	2.51
Electrode 5	10 times	233.15	3.79

Table S-5C. Repeatability data of anti-CEA/CeO₂-CNPs-Ch/ITO immunoelectrode with high CEA concentration (100 ng mL⁻¹)

Electrodes	Repetition of DPV response	Mean value (μA)	% RSD
Electrode 1	10 times	227.33	1.02
Electrode 2	10 times	226.68	0.32
Electrode 3	10 times	226.57	0.06
Electrode 4	10 times	226.40	0.25
Electrode 5	10 times	227.35	0.13

Selectivity test

The selectivity test of anti-CEA/CeO₂-CNPs-Ch/ITO immunoelectrode with CEA (1ng/mL) has been conducted by incorporating additional biomarkers NSE (1ng mL⁻¹), BSA (1ng mL⁻¹), histamine (80 μM) and L₁B₁ (50ng mL⁻¹) adrenaline hormone (30μM) and Vit-D₃ (50ng mL⁻¹) interferents as shown below **Fig. S-5**. No significant change observed in the current response in presence of these interferents.

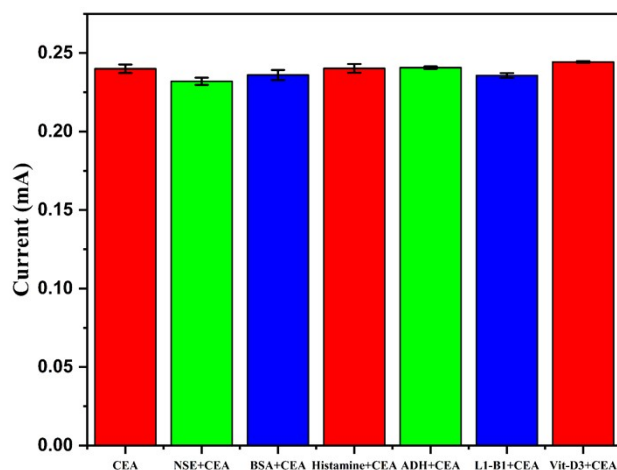


Fig. S-5. The selectivity test of anti-CEA/CeO₂-CNPs-Ch/ITO immunoelectrode with CEA (1ng mL⁻¹) in presence of NSE (1ng mL⁻¹), BSA (1ng mL⁻¹), histamine (80μM) and L₁B₁ (50ng mL⁻¹) biomarkers, adrenaline hormone (30μM), and Vit-D₃ (50ng mL⁻¹) interferents.