Enhancing Antioxidant Properties of CeO$_2$ Nanoparticles with Nd^{3+} Doping: Structural, Biological, and Machine Learning Insights

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Table 1. Structural parameters of the prepared NPs.

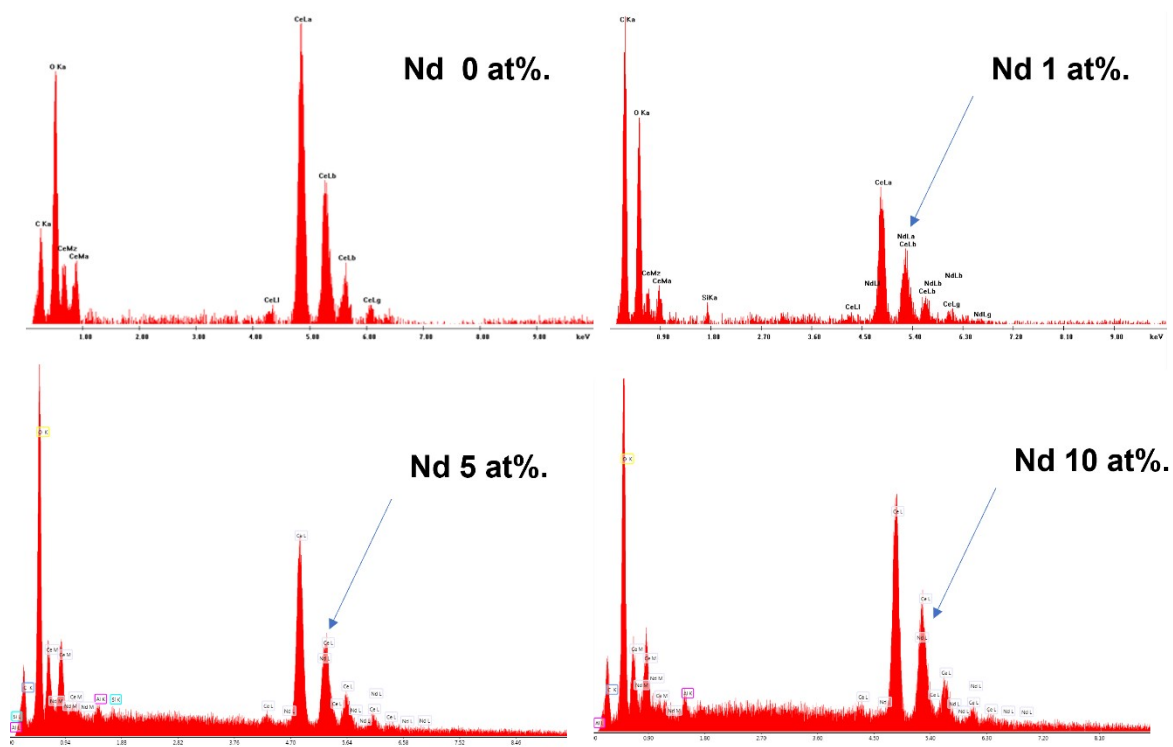| Sample	d_{hkl} (nm)	$2(\theta)$	FWHM	D (nm)	a (nm)
CN0	0.310	28.67	0.300	27.33	0.5261
CN1	0.311	28.66	0.313	26.20	0.5263
CN5	0.312	28.62	0.343	23.90	0.5270
CN10	0.312	28.58	0.445	18.42	0.5277

Figure S1. EDS spectrum of Nd-CeO$_2$ nanoparticles with different amounts of Nd.
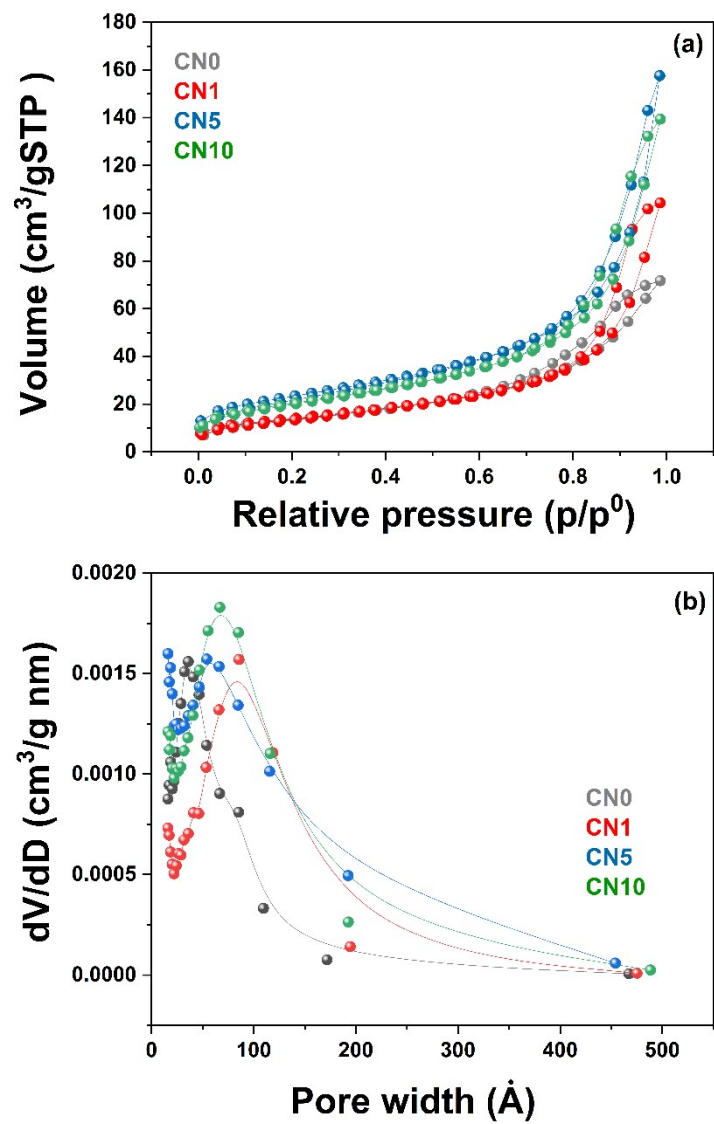
Figure S2. a) N$_2$-adsorption−desorption isotherm plots, b) pore size distribution of Nd-doped CeO$_2$ nanoparticles.

Table 2. S_{BET}, pore volume, and pore radius of prepared CeO_2-NPs.

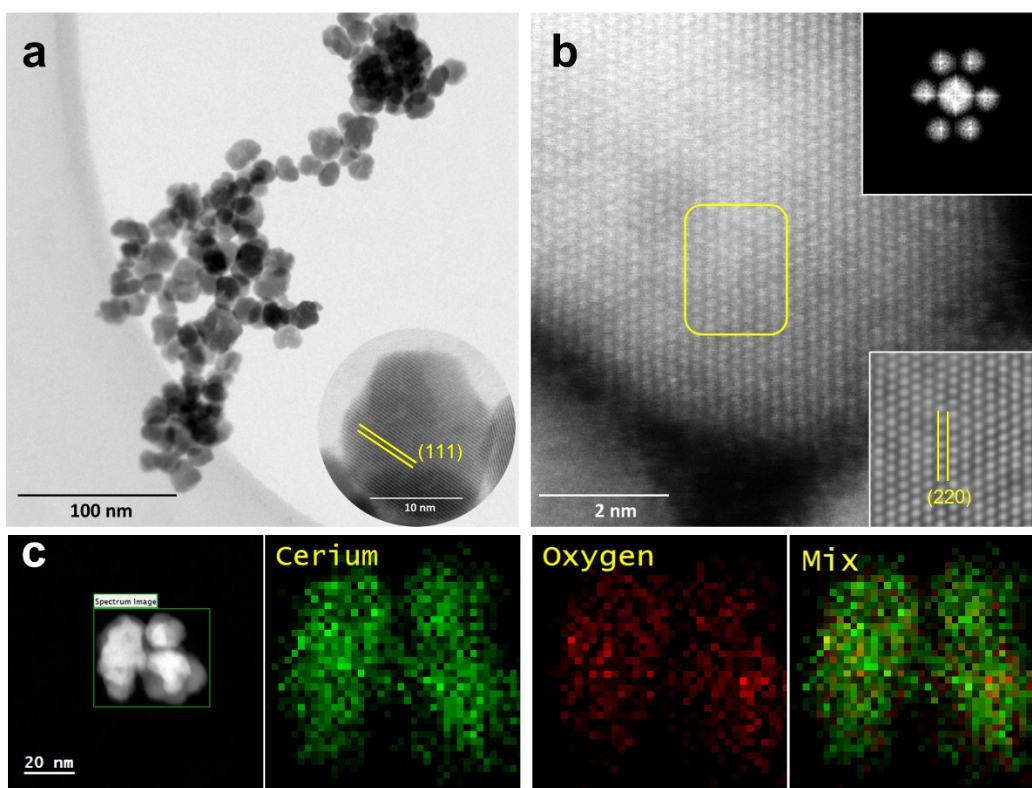| Sample	S_{BET} (m²/g)	Pore volume (cc/g)	Pore radius (Å)
CN0	49.240	0.106	35.824
CN1	50.004	0.157	85.610
CN5	83.815	0.233	16.057
CN10	73.258	0.208	66.815

Figure S3. a) TEM/HRTEM image, b) STEM-HAADF image (inset is the inverse FFT), and c) EDS elemental mapping of CeO_2.

TEM/HRTEM image of CeO_2 (**Figure S3**) depicts that the nanoparticles are consistent with the observed morphology. 17.25 nm was determined to be the average particle size. The (fast-Fourier Transform) FFT and inverse FFT were utilized to analyze the interplanar distance (dhkl) of 0.31 nm, leading to the identification of the (111) plane, as seen in the HRTEM inset. The surface's HRTEM picture in HAADF-STEM mode is shown in **Figure S3b**. In relation to the (220) plane, the dhkl value is 0.19 nm. Cerium and oxygen are represented by a homogeneous distribution in **Figure S3c** spectrum picture and elemental mapping. It also displays a blend of elemental mapping.