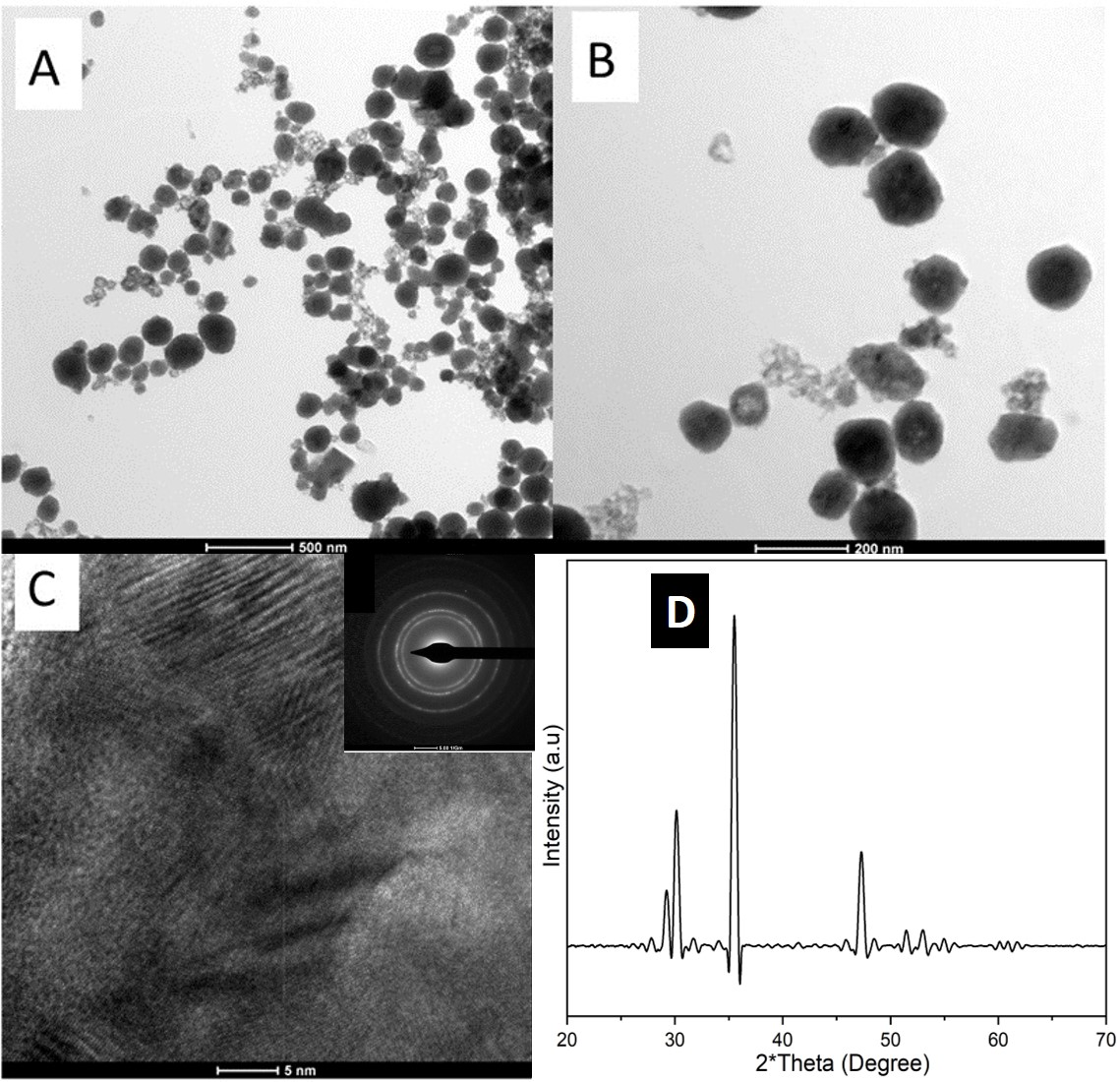
**Additional Data**

**Characterization of CPO**

The X-ray Diffractometer (XRD) analysis was conducted using the PANalytical X'pertPro instrument. The analysis covered a 2θ range from 10° to 100°, with a step size of 0.01°. A Cu target X-ray tube with a wavelength (λ) of 1.5406 Å was utilized for this purpose. To confirm the nanoparticle size, transmission electron microscopy (TEM) was employed. The TEM instrument used was the PHILIPS-CM 200, operating at a voltage range of 20–200 kV.

The XRD pattern of the synthesized CaO2 nanoparticles is presented in Supplementary Figure 1D. The presence of distinct peaks at 2θ values of 30.16, 35.5, 47.3, 51.5 and 53.1 confirms the formation of CaO2 nanoparticles46. In order to verify that the material consists solely of CaO2, the observed 2θ positions were compared with the 2θ positions of standard CaO2 (JCPDS-03-0865).

In addition, TEM analysis (Supplementary Fig. 1(A-C)) was performed to investigate the size and morphology of the CaO2 nanoparticles. The TEM images revealed that the CaO2 nanoparticles exhibited a spherical shape, with a size of less than 50 nm. The inset of Supplementary Fig. 1C displays the selected area electron diffraction pattern (SAED) of the CaO2 nanoparticles. The SAED pattern exhibits five distinct diffraction rings, indicating that the CaO2 nanoparticles possess a polycrystalline structure.

Supplementary Figure 1: Characterization of synthesized CaO2 nanoparticles. Transmission electron microscopic (TEM) images of CaO2 nanoparticles used in this project (A & B). High resolution TEM images showing the lattice fringes of CaO2 nanoparticles (C). XRD plot of CPO NPs (D).