Supporting Information

Figure S1. TG-DTA curves of Co$_3$O$_4$ precursors carried out under a flowing H$_2$/Ar (5 vol% H$_2$) atmosphere with a heating rate of 5°C min$^{-1}$ from ambient temperature to 500 °C.

Figure S2. SEM image of Co$_3$O$_4$. The products consist of a large quantity of monodispersed spheres. The spherical shape is very homogeneous, and the size of the nanospheres is about 250 nm with a very narrow size distribution.
Figure S3 (a) TEM image of Co@CoO, and (b) SEM image of Co@CoO. The inset in (b) is a single broken spherical shell and an exposed core.

Figure S4. (a) STEM-HADDF image of the core-shell structure. (b) EEL spectrum taken from point A of (a). It can be seen that both oxygen K-edge and cobalt L-edge are clearly revealed in the spectra at 540 and 785 eV, respectively. (c) EEL spectrum taken from point B of (a). The oxygen K-edge has nearly disappeared, which indicates that O is absent from the core. The EELS results confirm that the nanocomposites consist of the metal Co nanoparticles encapsulated in CoO.
Figure S5. TG curve of Co@CoO carried out under H₂/Ar (5 vol% H₂) with a heating rate of 5°C min⁻¹. The calculated content of CoO is 87.5% from the loss of 18.7 wt% oxygen in the TG profiles.
Figure S6. XRD pattern of Co after thermal treatment of 180 min in a flowing Ar/H₂ atmosphere.

Figure S7. (a) and (b) TEM images of pure CoO. It can be seen that the products have a homogeneous spherical shape and the sizes are similar to the Co@CoO sample.
Figure S8. View of the Co@CoO samples without void between Co core and CoO shell (a) XRD patterns, (b) TEM images, and (c) The capacity retention properties at a current density of 50 mAg\(^{-1}\) under 20 °C.