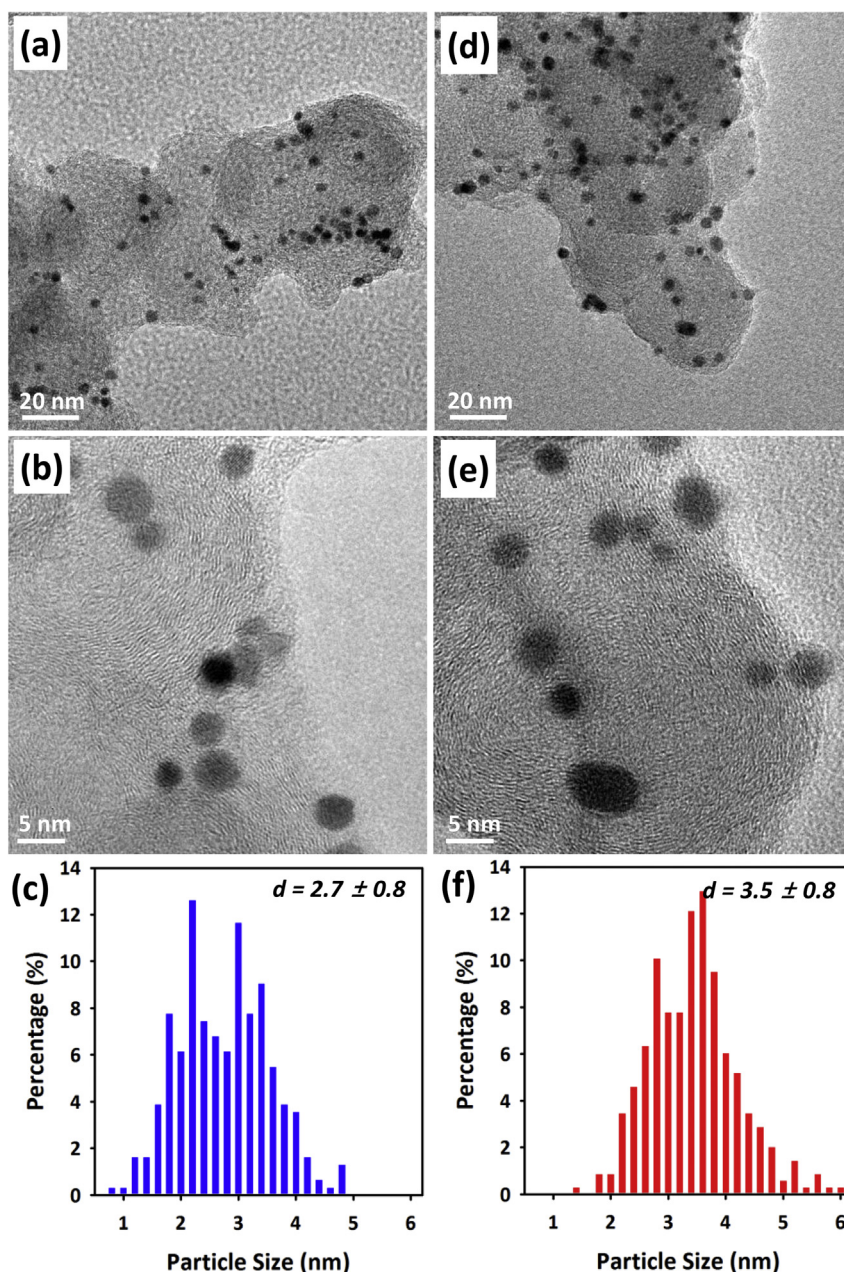


respectively (Fig. 2a,b and Table 1). With CO-stripping, consistent results were obtained. The ECSA<sub>CO</sub> of Pt/CB and Pt/CB<sub>2</sub>O decreased from 79.8 m<sup>2</sup> g<sub>Pt</sub><sup>-1</sup> to 57.1 m<sup>2</sup> g<sub>Pt</sub><sup>-1</sup> and from 117.8 m<sup>2</sup> g<sub>Pt</sub><sup>-1</sup> to 53.4 m<sup>2</sup> g<sub>Pt</sub><sup>-1</sup>, retaining 71.5% and 45.3% of their initial ECSAs, respectively (Fig. 2c,d and Table 1). The better durability of the Pt/CB was more clearly evidenced by the kinetic data obtained after the ADTs (Fig. 2e,f and Table 1). While the half-wave potential of Pt/CB was decreased by 12 mV (from 0.904 V to 0.892 V) after the ADT, Pt/CB<sub>2</sub>O underwent a more significant decrease of 23 mV (from 0.912 V to 0.889 V). In addition, the Pt/CB preserved 67.4% of the initial kinetic current density and mass activity after the ADT, which is substantially higher than that of Pt/CB<sub>2</sub>O (39.4%). The clear difference in the durability between Pt/CB and Pt/CB<sub>2</sub>O appears to arise from the different degrees of agglomeration of Pt nanoparticles. TEM images of the two catalysts after the ADTs (Fig. 3)

clearly revealed that the Pt/CB<sub>2</sub>O underwent more severe agglomeration during the durability tests; the size of Pt nanoparticles in Pt/CB<sub>2</sub>O (3.5 nm) was larger than that in Pt/CB (2.7 nm).

To identify molecular-level factors responsible for the ADT results, the two catalysts were studied by XPS, *in situ* XANES, and ICP-MS. The Pt 4f XPS spectra of the two catalysts (Fig. 4) showed doublet peaks at 71.8 eV and 75.2 eV, which can be deconvoluted into three peaks. The deconvoluted doublet peaks at 71.5 eV and 75.0 eV, 72.8 eV and 76.3 eV, and 74 eV and 77.5 eV can be ascribed to the Pt<sup>0</sup>, PtO, and PtO<sub>2</sub> phases, respectively [52]. We quantified the integrated areas of deconvoluted peaks in Pt 4f XPS spectra, and the results are presented in Table 2. The area corresponding to PtO<sub>2</sub> phase in the Pt/CB is 17.5%, and that in the Pt/CB<sub>2</sub>O is increased to 21.7%. On the other hand, the peak area for Pt is reduced from 53.2% in the Pt/CB to 50.3% in the Pt/CB<sub>2</sub>O. The trend becomes more



**Fig. 3.** (a, b) TEM images and (c) particle size distribution of Pt/CB after the ADTs; (d, e) TEM images and (f) particle size distribution of Pt/CB<sub>2</sub>O after the ADTs. (A colour version of this figure can be viewed online.)