Development of nickel and magnetite promoted carbonized cellulose beads supported bimetallic Pd-Pt catalysts for hydrogenation of chlorate ions in aqueous solution

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SUPPLEMENTARY INFORMATION

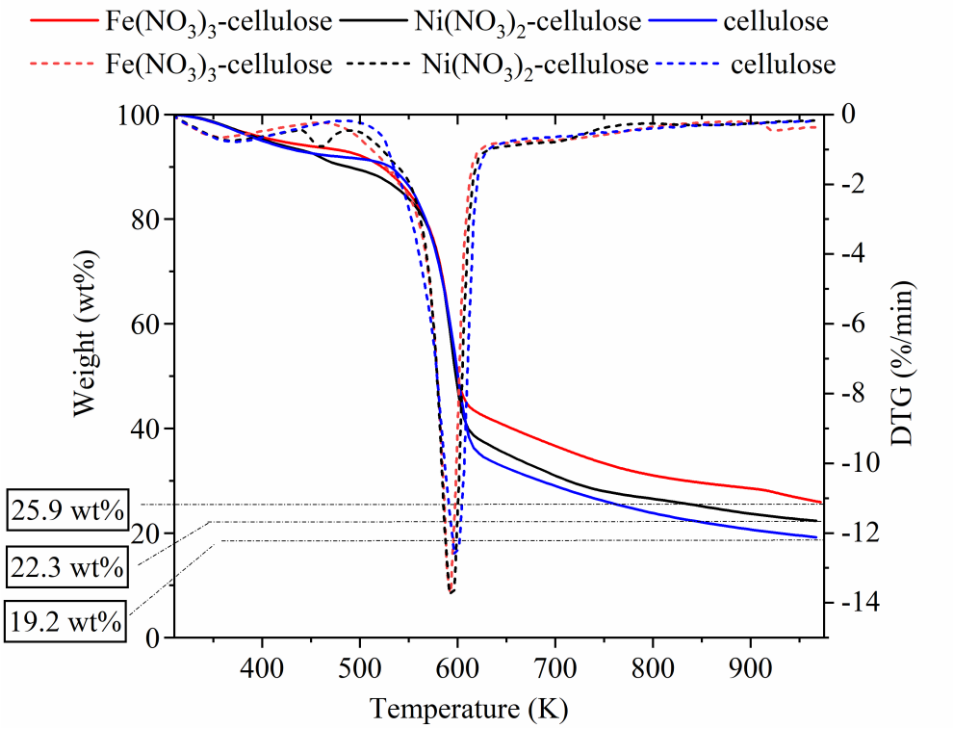

Figure S1. TG-DTG curves of the impregnated (with iron(III) nitrate or nickel(II) nitrate) cellulose beads (CB) and the non-impregnated sample.

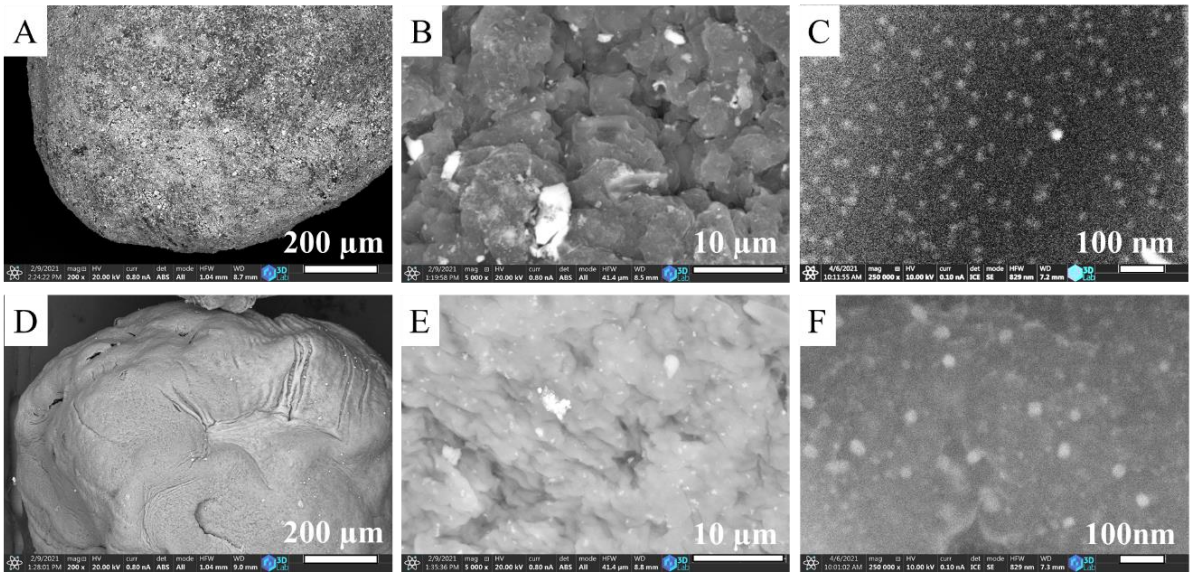

Figure S2. SEM images of the surface morphology of the Fe_3O_4-CCB (A-C), and Ni-CCB (D-F) catalyst supports.

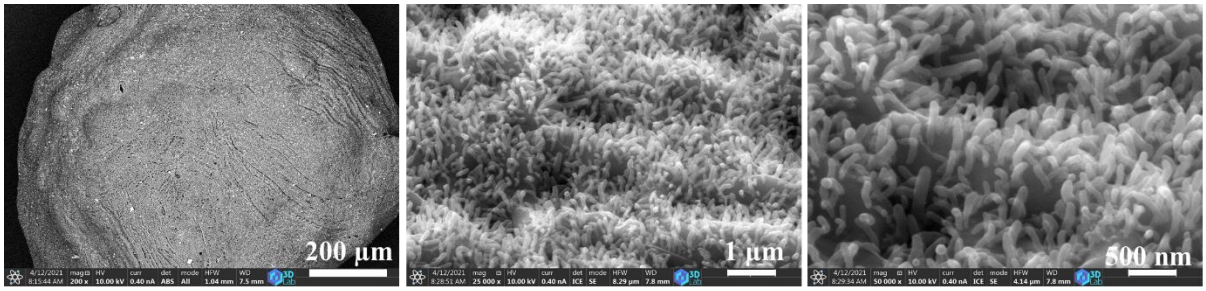

Figure S3. SEM images of the surface morphology of the non-impregnated carbonized cellulose bead (CCB) catalyst support.

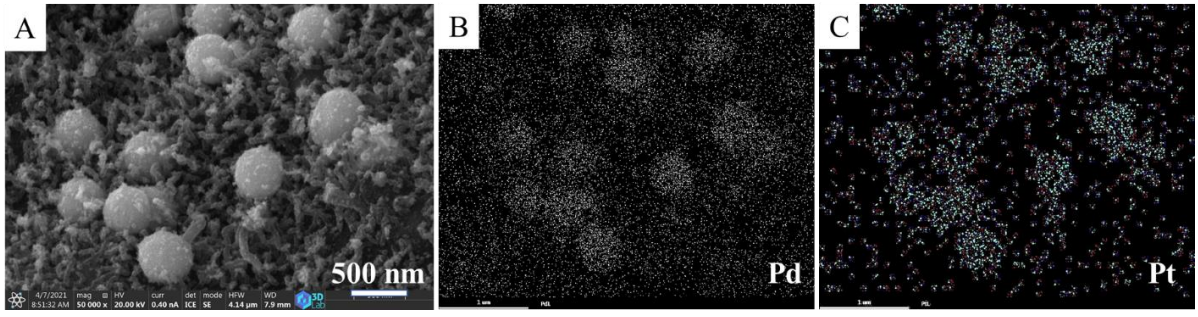

Figure S4. Elemental maps of the aggregated particles on the surface of the Pd-Pt/CCB catalyst with the localization of palladium (B) and platinum (C).

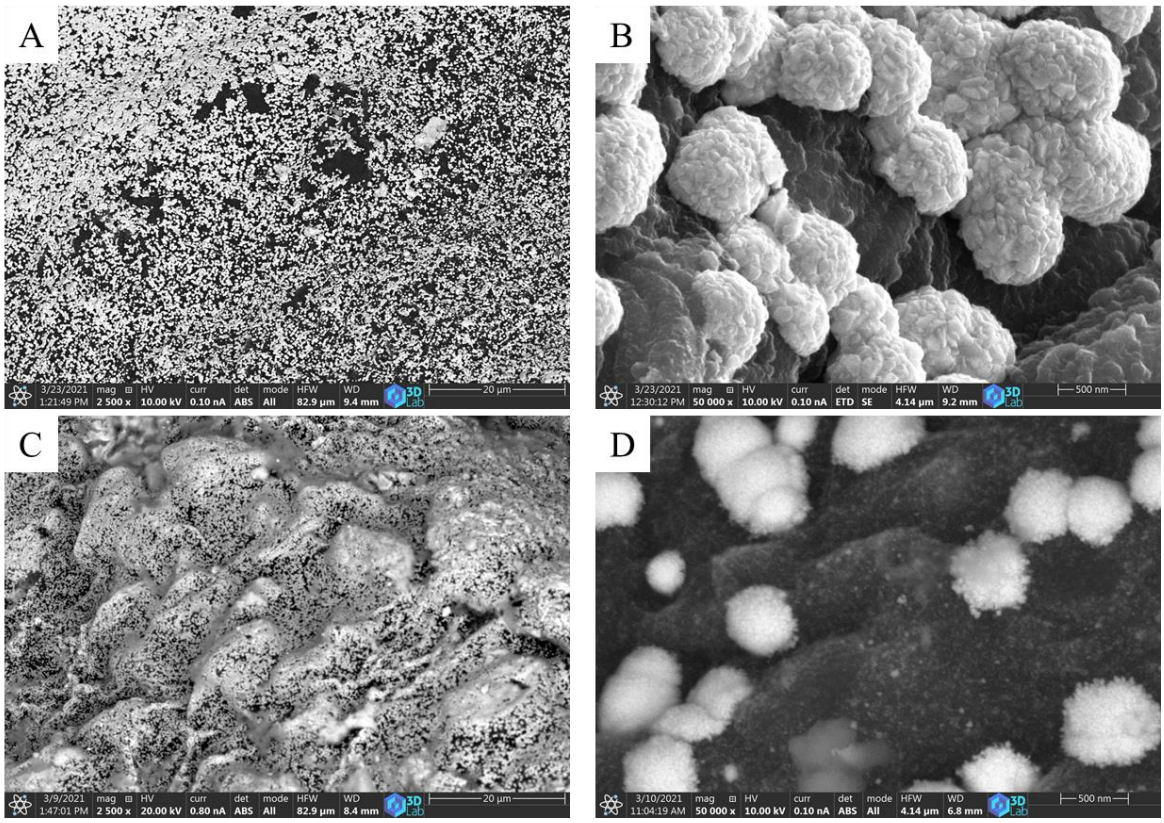

Figure S5. SEM images of the palladium and platinum nanoparticle based aggregated crystallites on the surface of the Fe_3O_4-CCB (A, B) and Ni-CCB (C, D) catalyst supports shown at different magnifications.

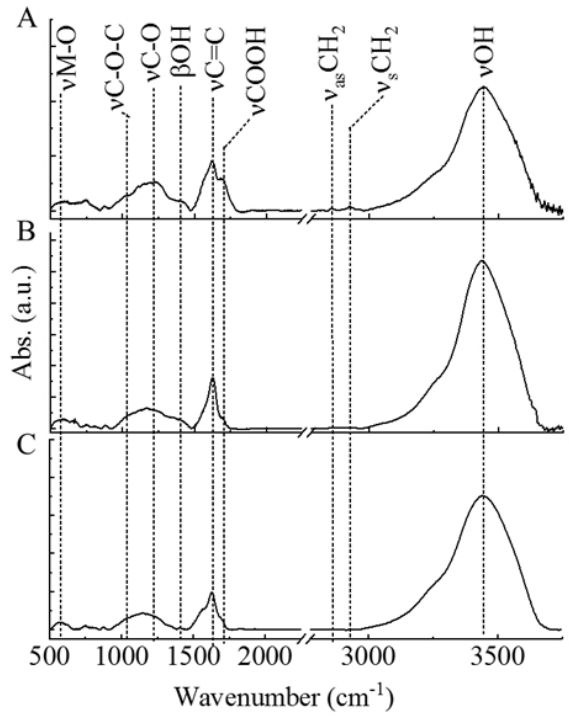

Figure S6. FTIR spectra of the 5 times used Pd-Pt/CCB (A), the Pd-Pt/Ni-CCB (B), Pd-Pt/Fe_3O_4-CCB (C) catalysts.

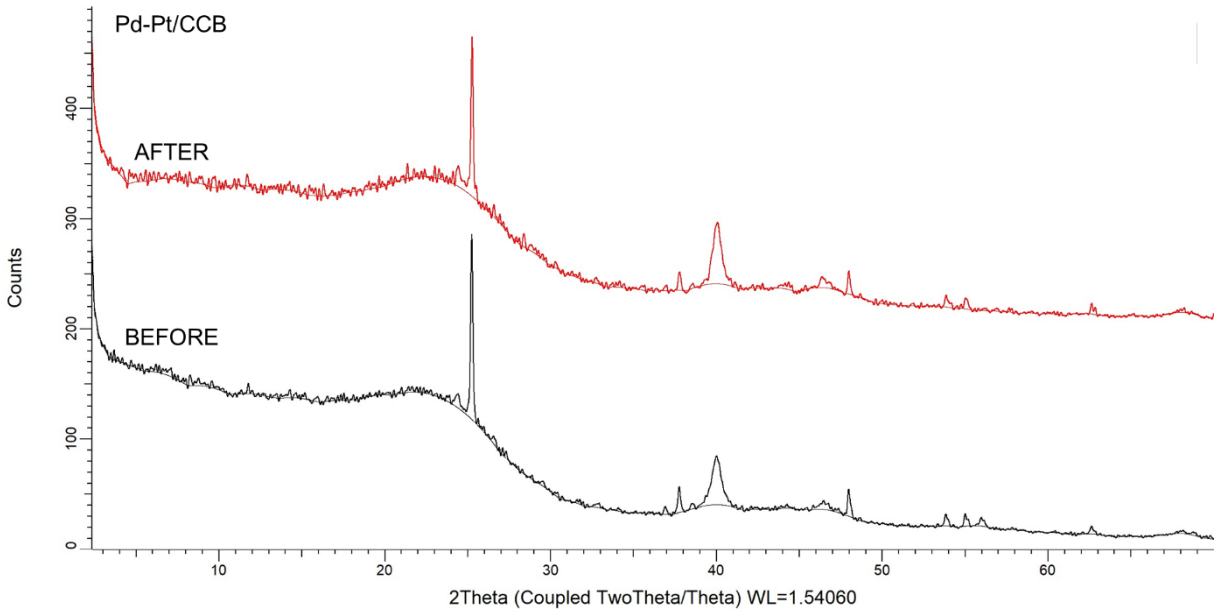

Figure S7. XRD patterns of the fresh (before) and the 5 times used (after) Pd-Pt/CCB catalyst.

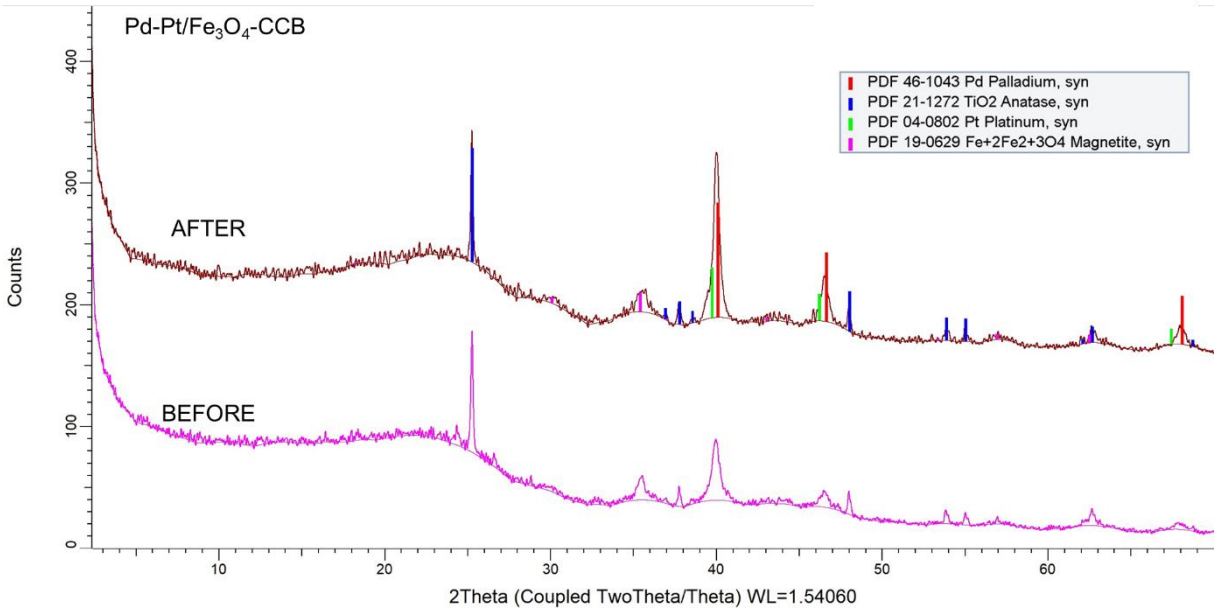

Figure S8. XRD patterns of the fresh (before) and the 5 times used (after) Pd-Pt/Fe_3O_4-CCB catalyst.

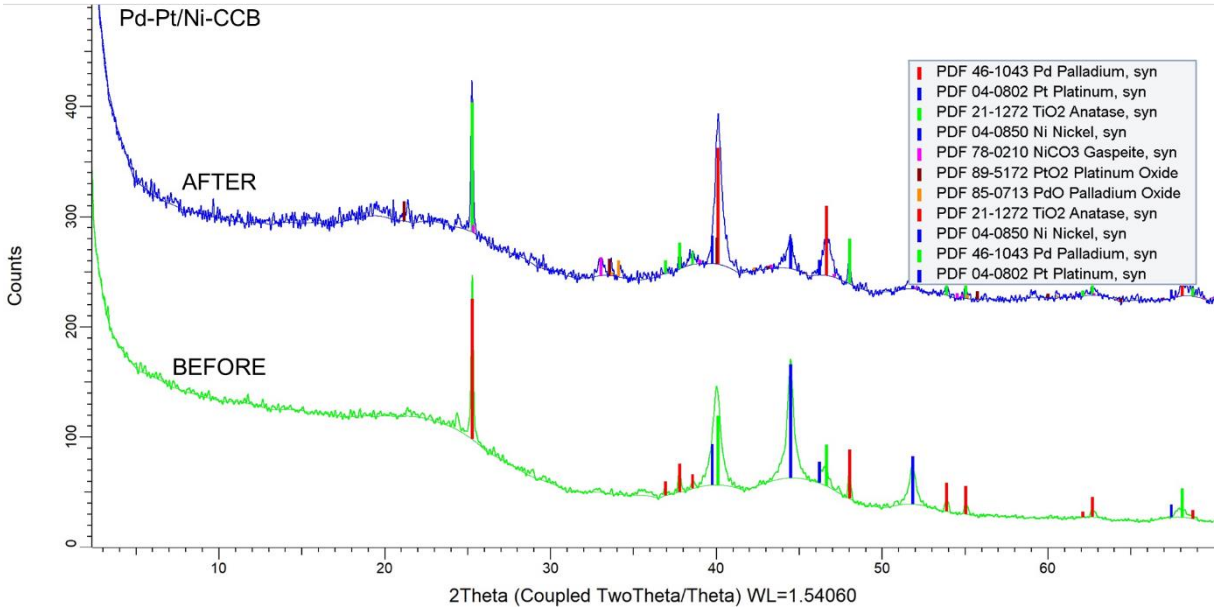

Figure S9. XRD patterns of the fresh (before) and the 5 times used (after) Pd-Pt/Ni-CCB catalyst.

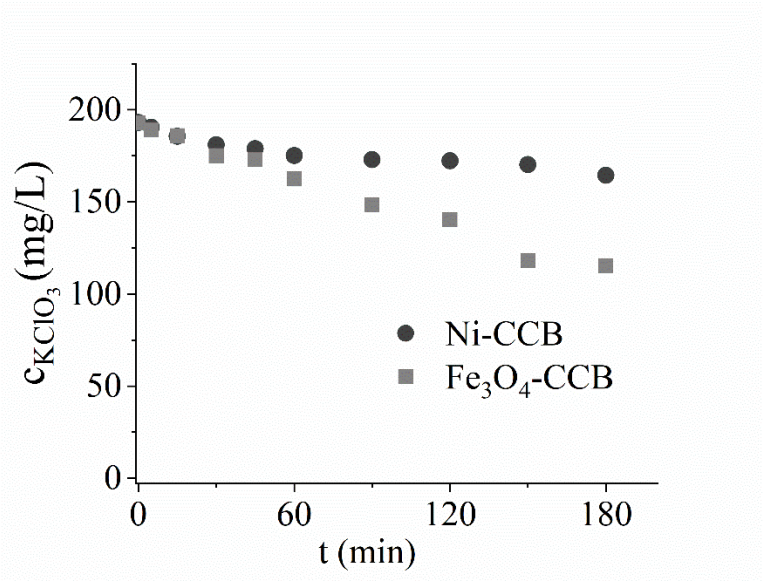

Figure S10. Chlorate conversion *vs.* time of hydrogenation. Catalytic activity of the Ni-CCB and Fe_3O_4-CCB supports.

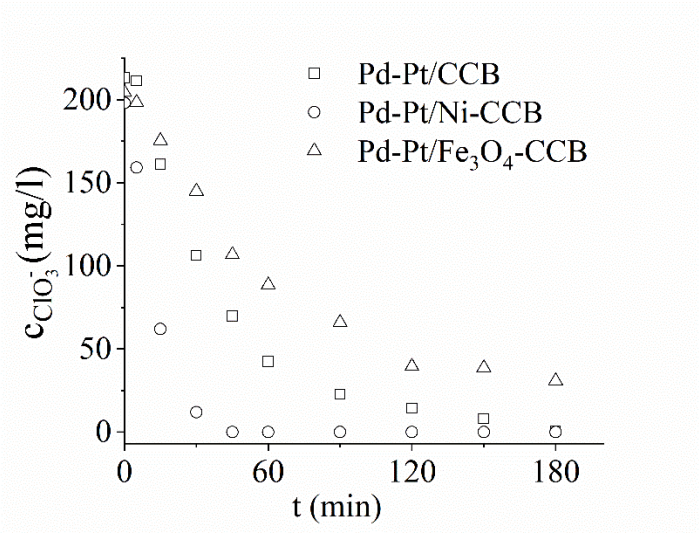

Figure S11. Chlorate conversion *vs.* time of hydrogenation by using the developed Pd-Pt/CCB, Pd-Pt/Ni-CCB, and Pd-Pt/Fe_3O_4-CCB catalysts.

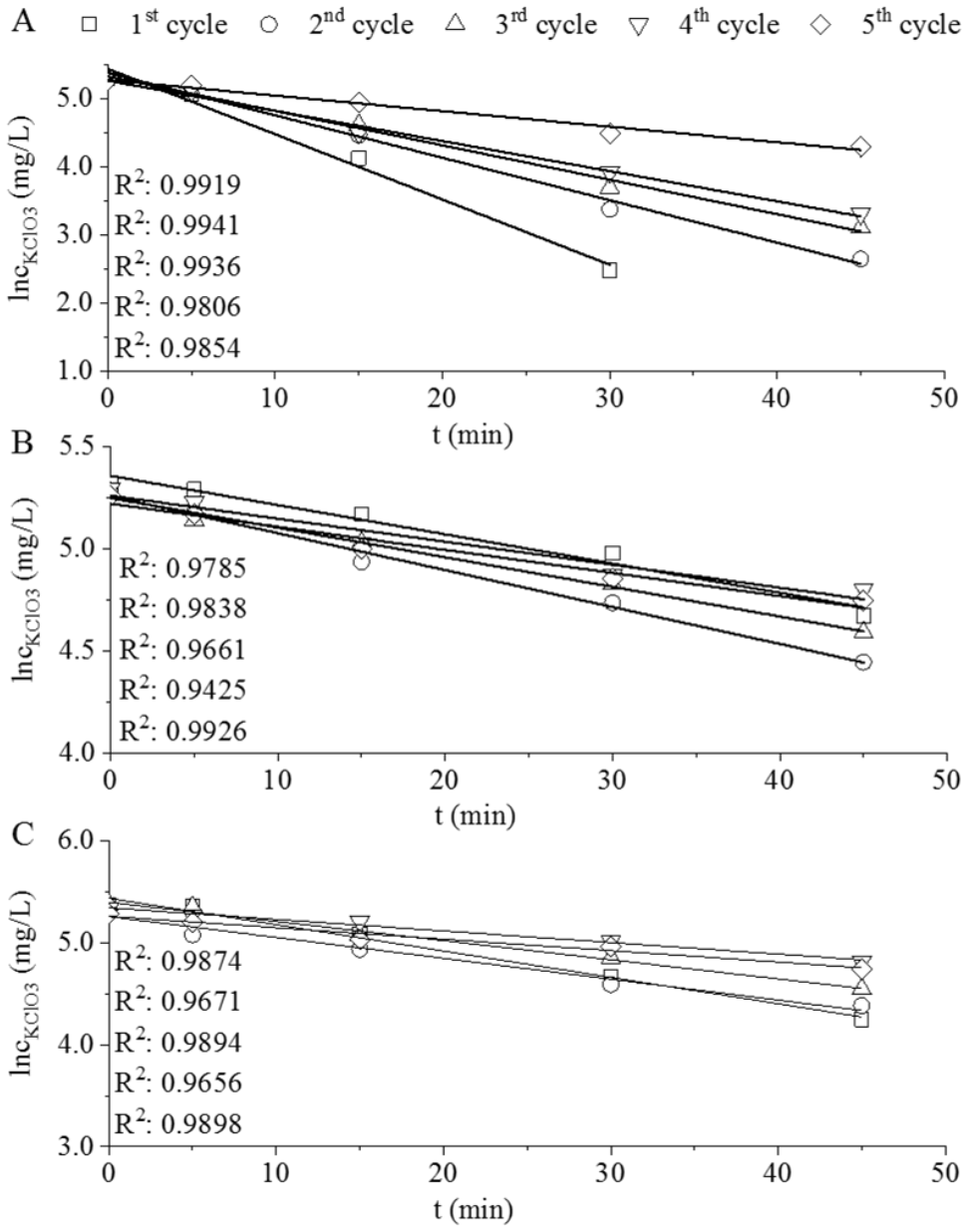

Figure S12. ln*c vs.* time (min) after the reuse tests by using the Pd-Pt/Ni-CCB (A), Pd-Pt/Fe_3O_4-CCB (B), and Pd-Pt/CCB (D) catalysts.

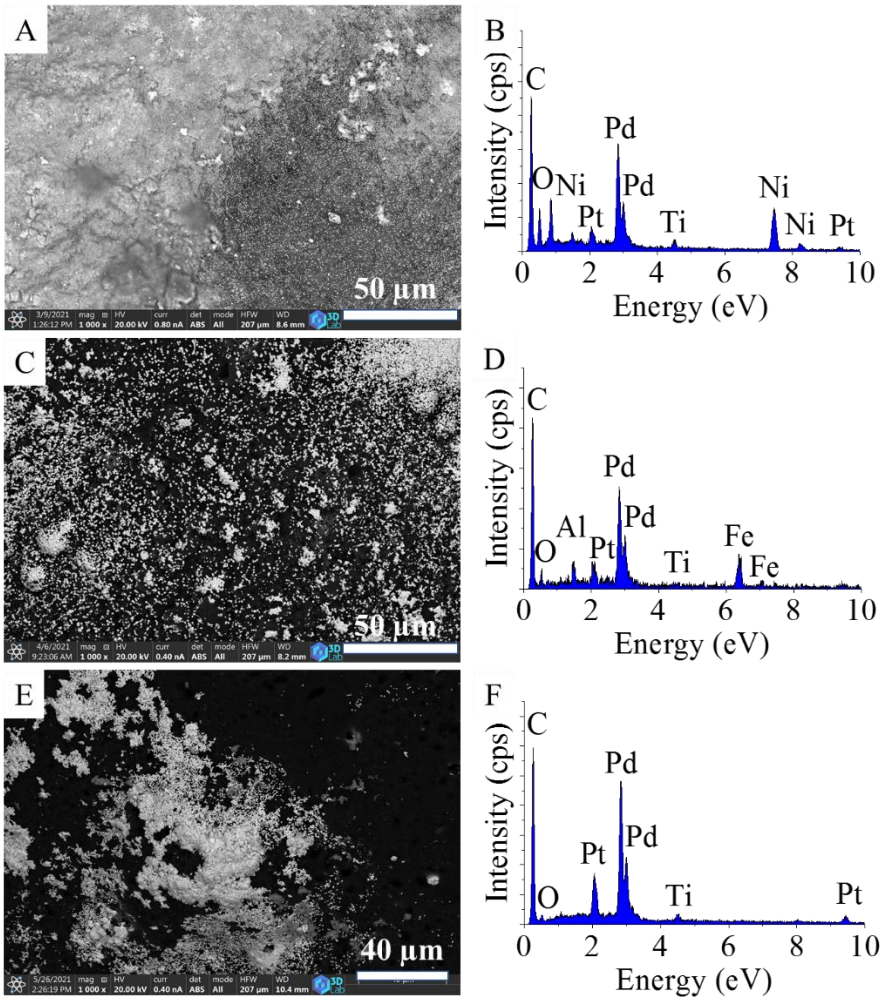

Figure S13. SEM images and EDS spectra of the Pd-Pt/Fe_3O_4-CCB (A, B), Pd-Pt/Ni-CCB (C, D), and Pd-Pt/CCB (E, F) catalyst after five reuse cycles.