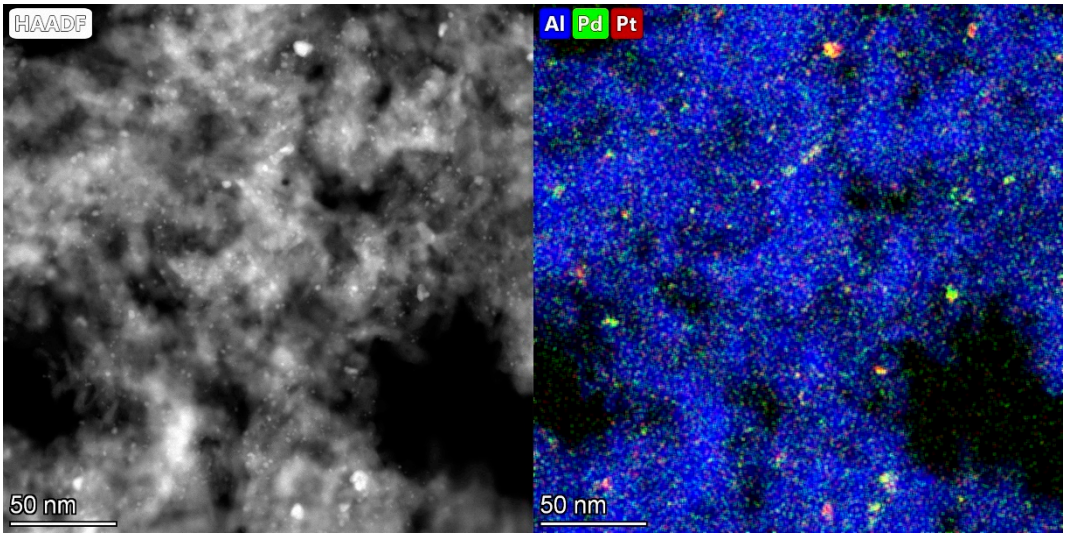


**Figure S1.** EDX mapping (in HAADF STEM mode) of the bimetallic PdPt/$Al_2O_3$ catalyst after reaction. It is clearly seen that small nanoparticles of few nanometers covered the support has a bimetallic structure. A few huge nanoparticles of 5-7 nm are found and has the bimetallic structure as well. It means that reaction.

**Table S1.** Structural parameters: coordination number, interatomic distance R (Å), and Debye-Waller factor $\sigma^2$ (Å$^2$), obtained from the refinement of experimental EXAFS data for the catalyst under study, as well as the energy shift $\Delta E_0$, and R-factor.

| Condition | Phase | Scattering | CN | R, Å | $\sigma^2$, Å$^2$ | $\Delta E_0$, eV | R-factor, % |
|---|---|---|---|---|---|---|---|
| **$Pd/Al_2O_3$ (Pd *K*-edge)** | | | | | | | |
| fresh | Metal (7%) | Pd | 2.9 | 2.756 | 0.004 | -0.5 | 0.5 |
| | Oxide (93%) | O (PdO) | 4.0 | 2.013 | 0.002 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 0.7 | 2.540 | 0.003 | | |
| | | Pd (PdO) | 2.6 | 3.038 | 0.003 | | |
| | | Pd (PdO) | 3.3 | 3.428 | 0.003 | | |
| 200 °C | Metal (4%) | Pd | 2.7 | 2.780 | 0.004 | -4.5 | 0.5 |
| | Oxide (96%) | O (PdO) | 4.0 | 2.021 | 0.003 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.0 | 2.432 | 0.004 | | |
| | | Pd (PdO) | 1.9 | 3.024 | 0.004 | | |
| | | Pd (PdO) | 3.0 | 3.430 | 0.004 | | |
| 300 °C | Metal (2%) | Pd | 2.0 | 2.784 | 0.005 | -7.0 | 1.5 |
| | Oxide (98%) | O (PdO) | 4.0 | 2.021 | 0.004 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.1 | 2.420 | 0.004 | | |
| | | Pd (PdO) | 0.9 | 3.001 | 0.004 | | |
| | | Pd (PdO) | 2.0 | 3.409 | 0.004 | | |
| 400 °C | Oxide (100%) | O (PdO) | 4.0 | 2.000 | 0.005 | -7.0 | 1.6 |
| | | $O_{Al}$ ($Al_2O_3$) | 1.2 | 2.420 | 0.004 | | |
| | | Pd (PdO) | 0.8 | 2.995 | 0.004 | | |
| | | Pd (PdO) | 2.0 | 3.395 | 0.004 | | |
| **$Pt/Al_2O_3$ (Pt $L_3$-edge)** | | | | | | | |
| fresh | Metal | Pt | 6.9 | 2.793 | 0.004 | 4.3 | 1.1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (25%) | | | | | | |
| | Oxide (75%) | O ($PtO_2$) | 6.0 | 2.014 | 0.003 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.2 | 2.354 | | | |
| | | Al ($Al_2O_3$) | 0.6 | 2.852 | | | |
| | | Pt ($PtO_2$) | 1.1 | 3.200 | | | |
| | | O ($PtO_2$) | 5.5 | 3.657 | | | |
| | | O ($PtO_2$) | 1.7 | 3.838 | | | |
| 200 °C | Metal (20%) | Pt | 4.5 | 2.793 | 0.004 | 5.1 | 0.7 |
| | Oxide (80%) | O ($PtO_2$) | 6.0 | 2.001 | 0.004 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.2 | 2.459 | | | |
| | | Al ($Al_2O_3$) | 0.6 | 2.793 | | | |
| | | Pt ($PtO_2$) | 0.9 | 3.181 | | | |
| | | O ($PtO_2$) | 3.3 | 3.696 | | | |
| | | O ($PtO_2$) | 1.3 | 3.835 | | | |
| 300 °C | Metal (16%) | Pt | 3.8 | 2.781 | 0.004 | 5.3 | 0.7 |
| | Oxide (84%) | O ($PtO_2$) | 6.0 | 1.997 | 0.004 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.2 | 2.462 | | | |
| | | Al ($Al_2O_3$) | 0.6 | 2.788 | | | |
| | | Pt ($PtO_2$) | 0.8 | 3.174 | | | |
| | | O ($PtO_2$) | 3.5 | 3.692 | | | |
| | | O ($PtO_2$) | 1.3 | 3.834 | | | |
| 400 °C | Metal (16%) | Pt | 3.4 | 2.781 | 0.005 | 5.8 | 1.1 |
| | Oxide (84%) | O ($PtO_2$) | 6.0 | 1.996 | 0.005 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.2 | 2.465 | | | |
| | | Al ($Al_2O_3$) | 0.6 | 2.788 | | | |
| | | Pt ($PtO_2$) | 0.8 | 3.177 | | | |
| | | O ($PtO_2$) | 3.4 | 3.690 | | | |
| | | O ($PtO_2$) | 1.1 | 3.834 | | | |
| **$PdPt/Al_2O_3$ (Pd *K*-edge)** | | | | | | | |
| fresh | Metal (9%) | Pd/Pt | 1.5 | 2.703 | 0.003 | 1.0 | 0.7 |
| | Oxide (91%) | O (PdO) | 4.0 | 2.003 | 0.002 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.3 | 2.440 | 0.003 | | |
| | | Al ($Al_2O_3$) | 0.2 | 2.903 | 0.003 | | |
| | | Pd/Pt (PdO) | 0.6 | 3.236 | 0.003 | | |
| | | Pd/Pt (PdO) | 1.0 | 3.400 | 0.003 | | |
| 200 °C | Metal (12%) | Pd/Pt | 0.9 | 2.818 | 0.004 | -2.3 | 0.9 |
| | Oxide (88%) | O (PdO) | 4.0 | 2.016 | 0.005 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.0 | 2.443 | 0.004 | | |
| | | Al ($Al_2O_3$) | 0.2 | 2.903 | 0.004 | | |
| | | Pd/Pt (PdO) | 0.6 | 3.242 | 0.004 | | |
| | | Pd/Pt (PdO) | 0.9 | 3.429 | 0.004 | | |
| 300 °C | Metal (10%) | Pd/Pt | 1.0 | 2.812 | 0.004 | 0.7 | 1.1 |
| | Oxide (90%) | O (PdO) | 4.0 | 2.021 | 0.006 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.1 | 2.453 | 0.004 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Al ($Al_2O_3$) | 0.2 | 2.903 | 0.004 | | |
| | | Pd/Pt (PdO) | 0.6 | 3.287 | 0.004 | | |
| | | Pd/Pt (PdO) | 1.0 | 3.405 | 0.004 | | |
| 400 °C | Metal (10%) | Pd/Pt | 0.9 | 2.815 | 0.004 | 1.1 | 1.2 |
| | Oxide (90%) | O (PdO) | 4.0 | 2.018 | 0.006 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.1 | 2.453 | 0.004 | | |
| | | Al ($Al_2O_3$) | 0.2 | 2.903 | 0.004 | | |
| | | Pd/Pt (PdO) | 0.6 | 3.115 | 0.004 | | |
| | | Pd/Pt (PdO) | 0.9 | 3.331 | 0.004 | | |
| **$PdPt/Al_2O_3$ (Pt $L_3$-edge)** | | | | | | | |
| fresh | Metal (25%) | Pt | 4.0 | 2.826 | 0.003 | 5.3 | 1.5 |
| | Oxide (75%) | O ($PtO_2$) | 6.0 | 2.017 | 0.003 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.3 | 2.313 | | | |
| | | Al ($Al_2O_3$) | 0.4 | 2.872 | | | |
| | | Pt ($PtO_2$) | 1.6 | 3.240 | | | |
| | | O ($PtO_2$) | 5.8 | 3.680 | | | |
| | | O ($PtO_2$) | 1.0 | 3.881 | | | |
| 200 °C | Metal (26%) | Pt | 3.6 | 2.793 | 0.004 | 5.1 | 1.6 |
| | Oxide (74%) | O ($PtO_2$) | 6.0 | 2.000 | 0.003 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.5 | 2.486 | | | |
| | | Al ($Al_2O_3$) | 0.6 | 2.770 | | | |
| | | Pt ($PtO_2$) | 0.8 | 3.200 | | | |
| | | O ($PtO_2$) | 3.3 | 3.576 | | | |
| | | O ($PtO_2$) | 1.3 | 3.707 | | | |
| 300 °C | Metal (24%) | Pt | 3.4 | 2.781 | 0.004 | 5.3 | 1.2 |
| | Oxide (76%) | O ($PtO_2$) | 6.0 | 2.001 | 0.004 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.2 | 2.488 | | | |
| | | Al ($Al_2O_3$) | 0.6 | 2.737 | | | |
| | | Pt ($PtO_2$) | 0.9 | 3.179 | | | |
| | | O ($PtO_2$) | 3.5 | 3.578 | | | |
| | | O ($PtO_2$) | 1.1 | 3.708 | | | |
| 400 °C | Metal (25%) | Pt | 2.8 | 2.782 | 0.004 | 8.1 | 1.3 |
| | Oxide (75%) | O ($PtO_2$) | 6.0 | 1.997 | 0.004 | | |
| | | $O_{Al}$ ($Al_2O_3$) | 1.2 | 2.472 | | | |
| | | Al ($Al_2O_3$) | 0.6 | 2.778 | | | |
| | | Pt ($PtO_2$) | 0.8 | 3.177 | | | |
| | | O ($PtO_2$) | 3.5 | 3.553 | | | |
| | | O ($PtO_2$) | 1.1 | 3.693 | | | |