Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information for

Robust Ir Doping of Sub-one-nanometer PtMn Nanowires: Highly Active and Stable Catalysts for Alcohols Electrooxidation

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1. Supporting figures and tables

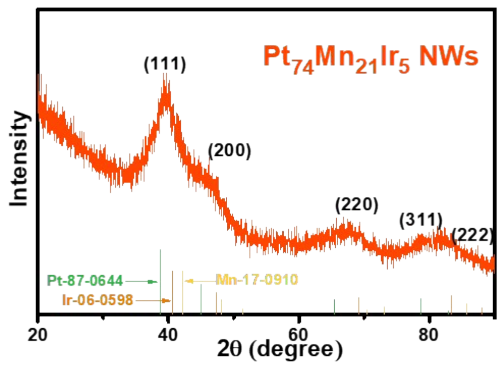

Fig. S1 XRD pattern of $Pt_{74}Mn_{21}Ir_5$ NWs.

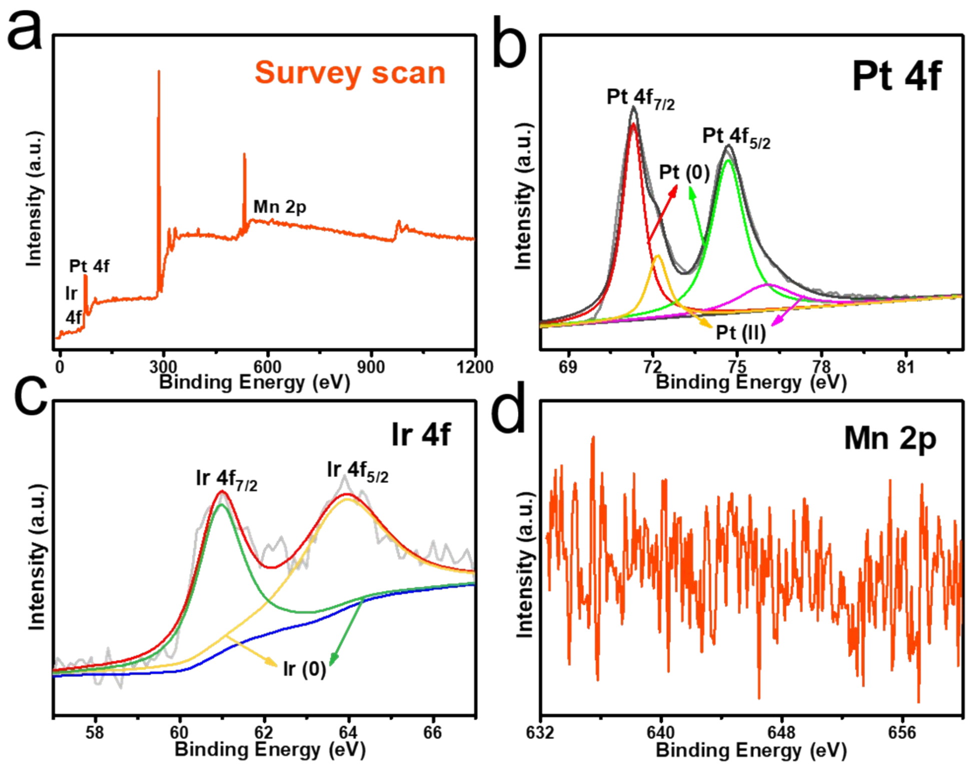

Fig. S2 XPS spectra of (a) survey scan, (b) Pt 4f, (c) Ir 4f, (d) Mn 2p in $Pt_{74}Mn_{21}Ir_5$ NWs.

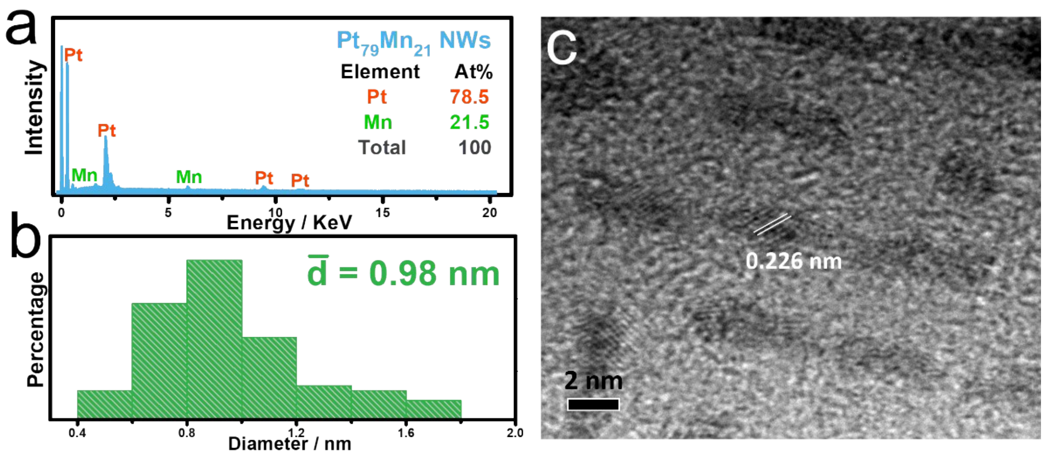

Fig. S3 Representative (a) SEM-EDS spectrum, (b) size distribution of the diameter, (c) HRTEM image as-prepared $Pt_{79}Mn_{21}$ NWs.

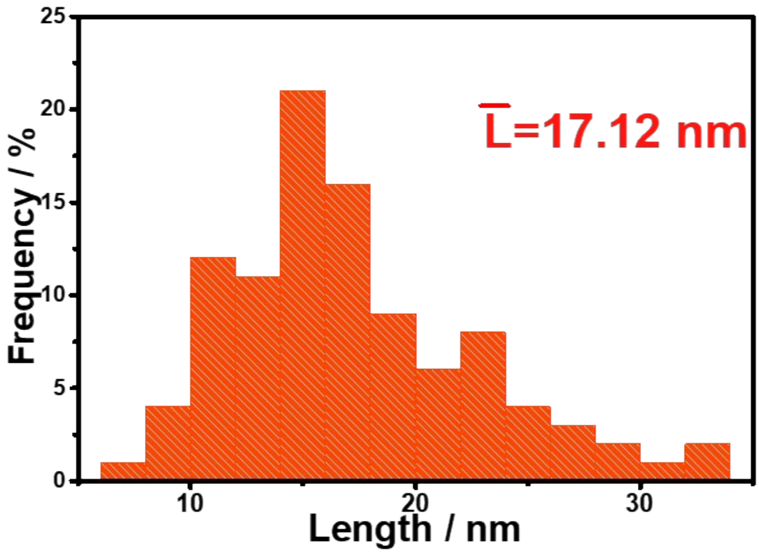

Fig. S4 Size distribution of the length of $Pt_{79}Mn_{21}$ NWs.

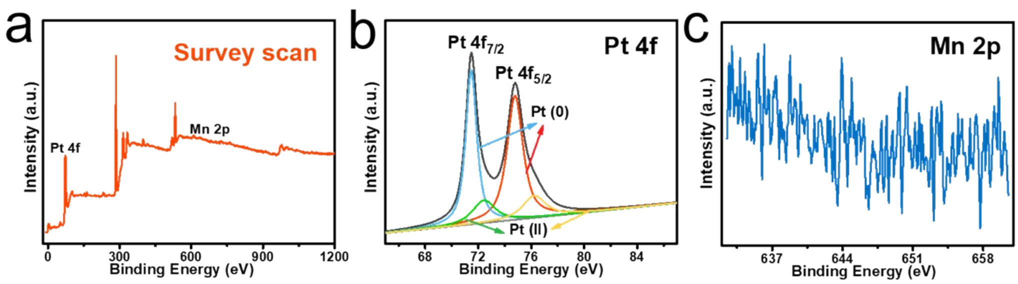

Fig. S5 XPS spectra of (a) survey scan, (b) Pt 4f, (c) Mn 2p in $Pt_{79}Mn_{21}$ NWs.

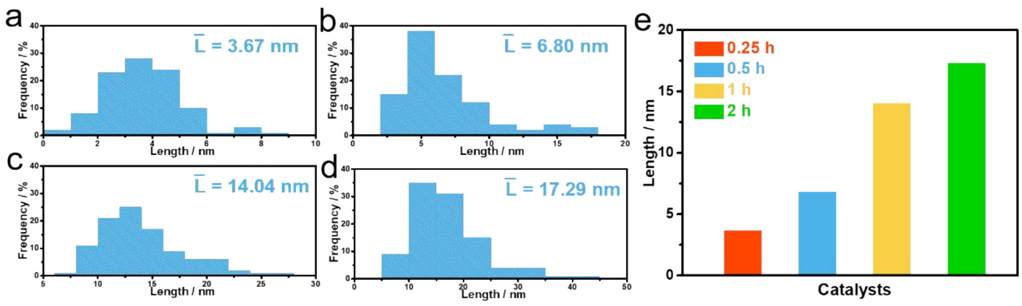

Fig. S6 The average length of $Pt_{74}Mn_{21}Ir_5$ NWs intermediates collected after the reaction had prolonged for (a) 0.25, (b) 0.5, (c) 1, and (d) 2 h. (e) the average length variation of $Pt_{74}Mn_{21}Ir_5$ NWs intermediates.

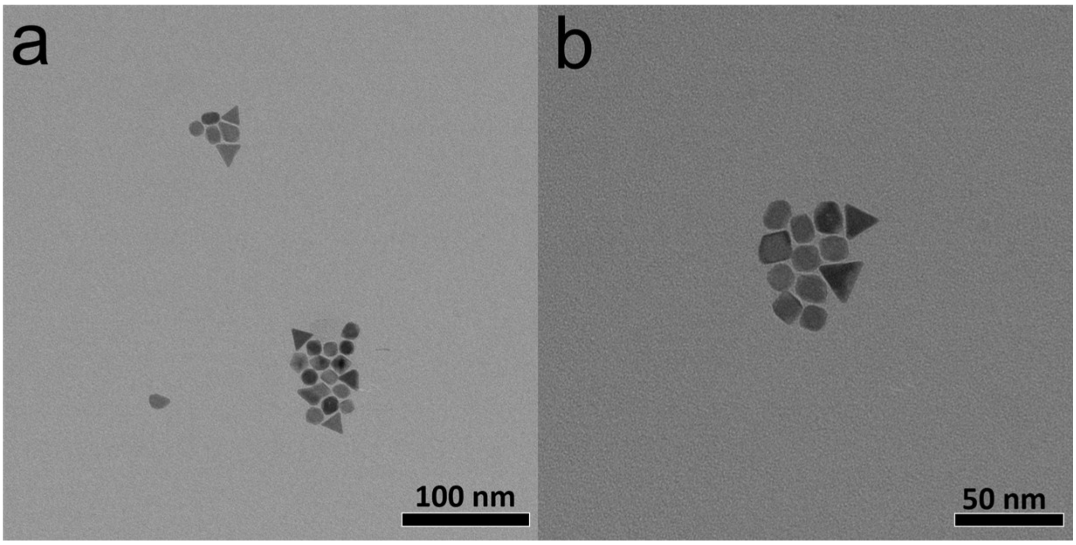

Fig. S7 (a and b) TEM images of the products with the same reaction conditions as that of $Pt_{74}Mn_{21}Ir_5$ NWs without the addition of $Mo(CO)_6$.

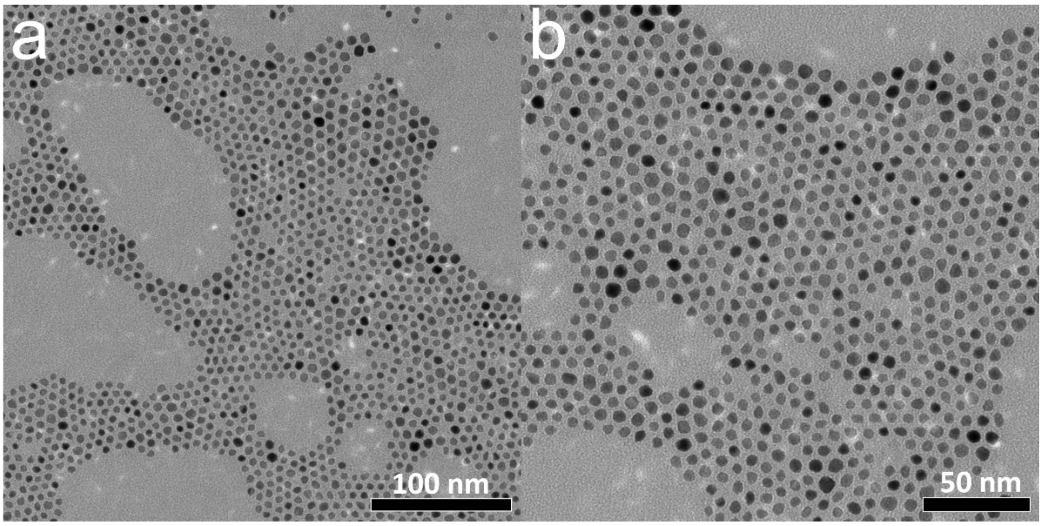

Fig. S8 (a and b) TEM images of the products with the same reaction conditions as that of $Pt_{74}Mn_{21}Ir_5$ NWs without the addition of CTAC.

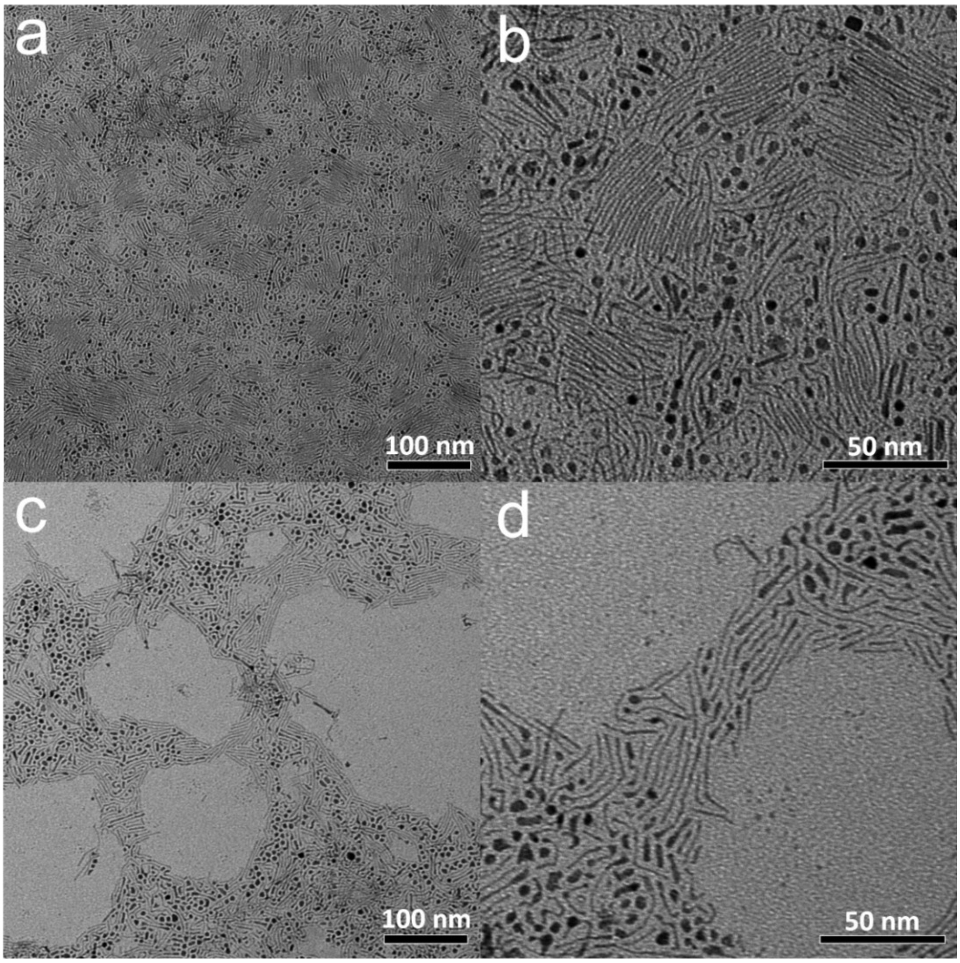

Fig. S9 TEM images of the products with the same reaction conditions as that of (a and b) $Pt_{74}Mn_{21}Ir_5$ NWs and (c and d) $Pt_{79}Mn_{21}$ NWs without the addition of ODE.

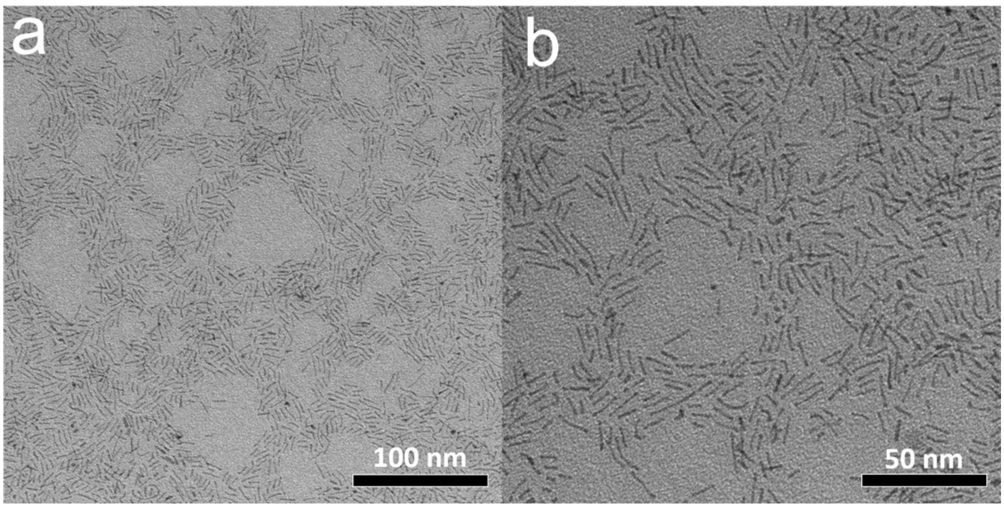

Fig. S10 Representative TEM images of (a and b) Pt NWs.

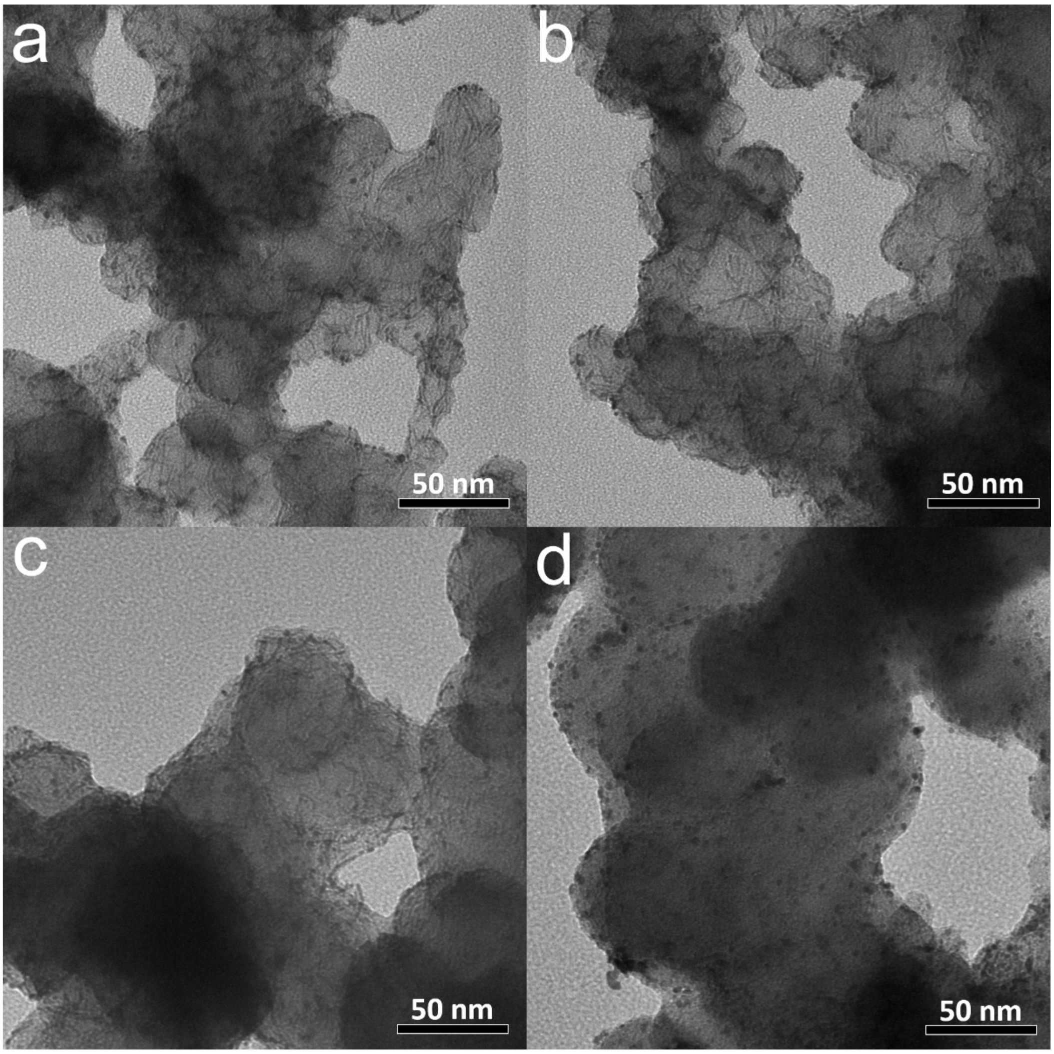

Fig. S11 TEM images of (a) $Pt_{74}Mn_{21}Ir_5$ NWs, (b) $Pt_{79}Mn_{21}$ NWs, (c) Pt NWs, and (d) Pt/C catalysts before electrochemical tests.

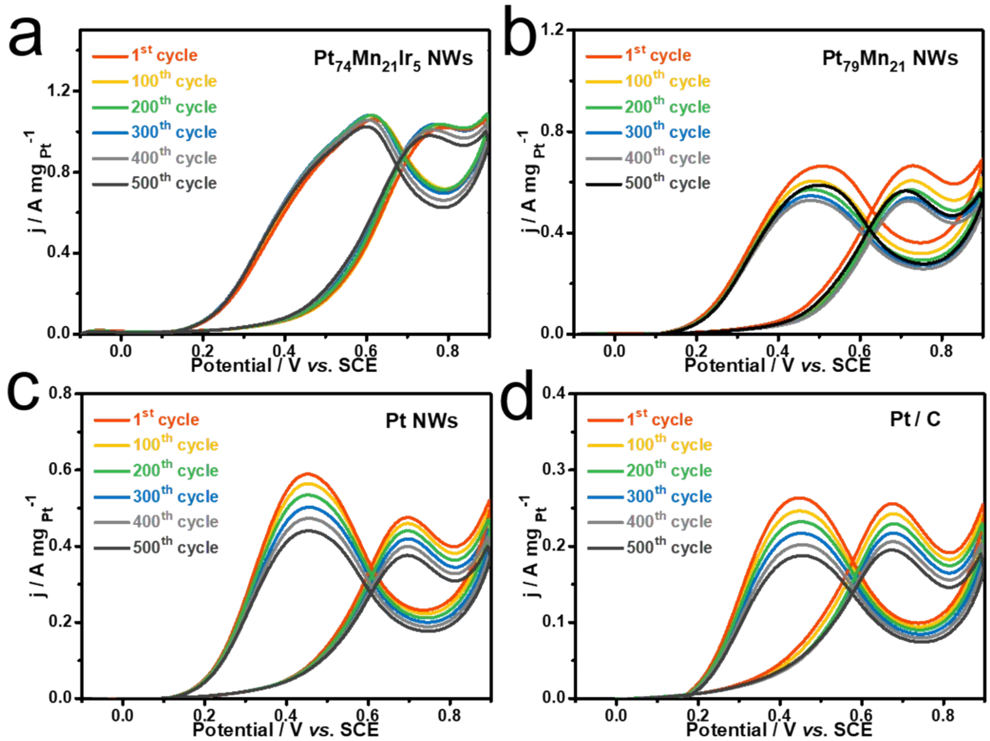

Fig. S12 CV (1st, 100th, 200th, 300th, 400th and 500th) curves of (a) $Pt_{74}Mn_{21}Ir_5$ NWs, (b) $Pt_{79}Mn_{21}$ NWs, (c) Pt NWs, (d) Pt/C catalysts recorded in 0.1 M $HClO_4$ + 0.5 M ethanol solution.

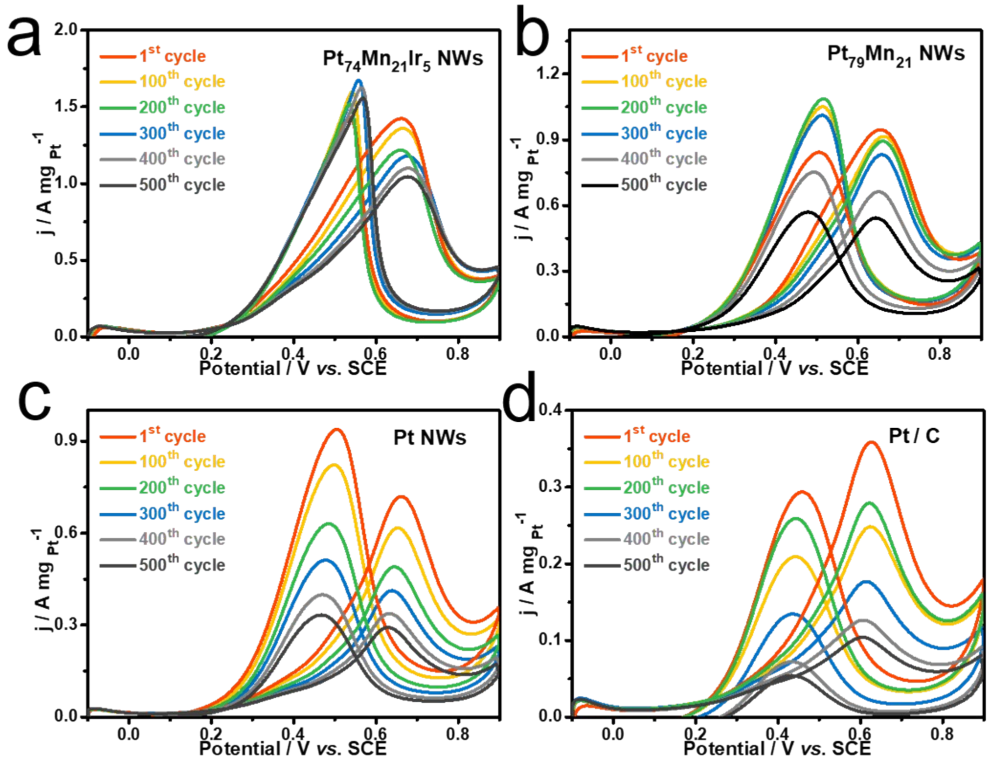

Fig. S13 CV (1st, 100th, 200th, 300th, 400th and 500th) curves of (a) $Pt_{74}Mn_{21}Ir_5$ NWs, (b) $Pt_{79}Mn_{21}$ NWs, (c) Pt NWs, (d) Pt/C catalysts recorded in 0.1 M $HClO_4$ + 0.5 M methanol solution.

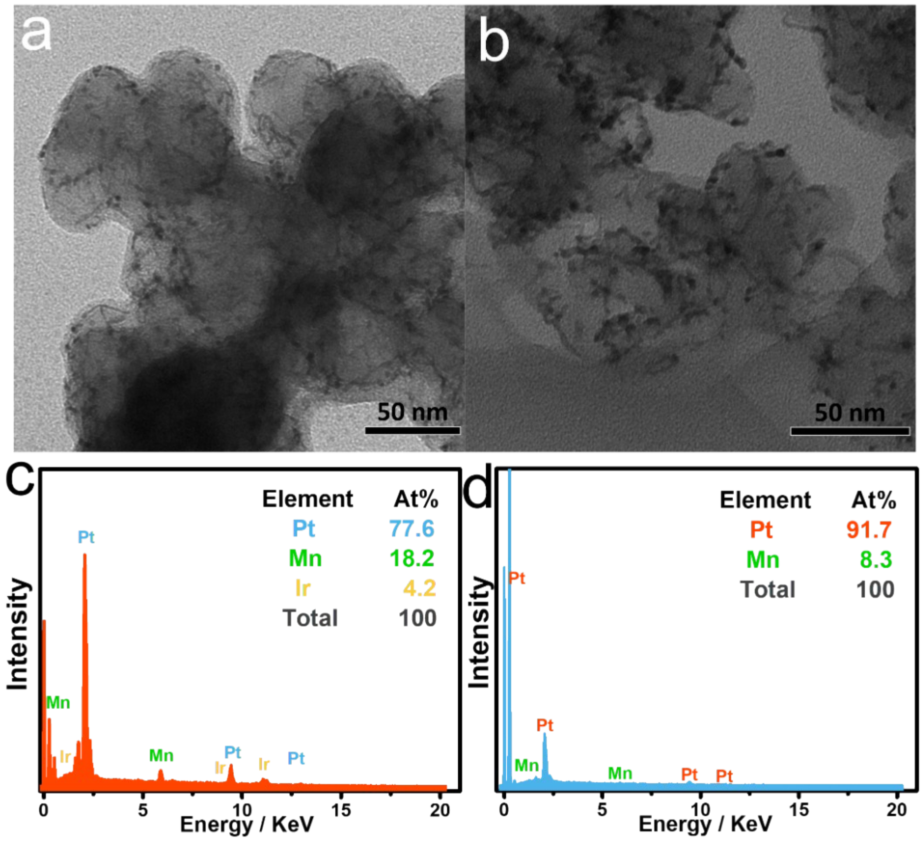

Fig. S14 (a and c) TEM images and (b and d) EDS spectrum of $Pt_{74}Mn_{21}Ir_5$ NWs and $Pt_{79}Mn_{21}$ NWs after stability tests.

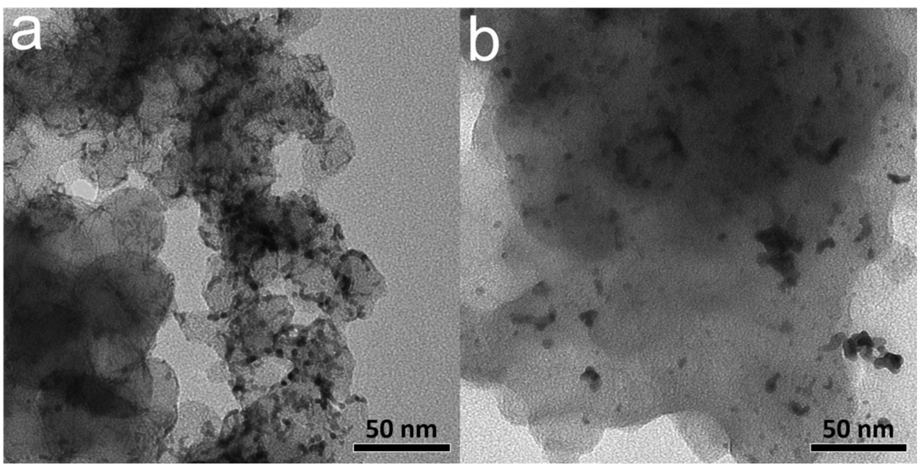

Fig. S15 TEM images of (a) Pt NWs and (b) Pt/C catalysts after stability tests.

Table S1. EOR performances of $Pt_{74}Mn_{21}Ir_5$ NWs and various electrocatalysts from published works.

Catalysts	Peak currents from CV curves		Electrolyte	Reference
	J_m (A mg^{-1})	J_s (mA cm^{-2})		
$Pt_{74}Mn_{21}Ir_5$ NWs	1.02		0.1 M $HClO_4$ + 0.5 M Ethanol	This work
Pt-Cu Nanocone	~ 0.4	2.97	0.5 M H_2SO_4 + 0.1 M Ethanol	*J. Am. Chem. Soc.* **2013**, 135, 18304-18307.
THH PtNi NFs	0.77	1.99	0.5 M H_2SO_4 + 0.1 M Ethanol	*Nano Lett.* **2016**, 16, 2762-2767.
RDH PtNi NFs	0.98	1.79		
PtRhNi/C	0.378		0.5 M $HClO_4$ + 1 M Ethanol	*ChemElectroChem* **2015**, 2, 903-908
$PtPb_{0.27}$ NWs	~ 1.7	~ 0.9	0.1 M $HClO_4$ + 0.15 M Ethanol	*Chem. Mater.* **2016**, 28, 4447-4452.
$PtCu_{2.1}$ NWs	1.015	2.16	0.1 M $HClO_4$+ 0.2 M Ethanol	*Nano Lett.* **2016**, 16, 5037−5043
RuNi@PtRu/ SWCNT	0.9534		0.5 M H_2SO_4+ 1 M Ethanol	*Energy Environ. Sci.* **2011**, 4, 4513-4516.
PtRh NW/GNS	1	2.8	1 M H_2SO_4 + 1 M Ethanol	*ACS Appl. Mater. Interface* **2017**, 9, 3535-3543

Table S2. MOR performances of $Pt_{74}Mn_{21}Ir_5$ NWs and various electrocatalysts from published works.

Catalysts	Peak currents from CV curves		Electrolyte	Reference
	J_m (A mg^{-1})	J_s (mA cm^{-2})		
$Pt_{74}Mn_{21}Ir_5$ NWs	1.42		1 M $HClO_4$ + 1 M methanol	This work
Pt_3Cu Nanoicosahedra	0.736	2.14	0.1 M $HClO_4$ + 0.2 M methanol	*ACS Nano*, **2015**, 9, 7634-7640
Pt_3Cu Nanoctahedra	0.518	1.63		
PtFe NWs		1.20	0.5 M H_2SO_4 + 1 M Methanol	*Chem. Eur. J.* **2013**, 19, 233-239.
PtNi Concave Nanoctahedra	0.44	1.55	0.1 M $HClO_4$ and 1 M Methanol	*Angew. Chem. Int. Ed.* **2012**, 51, 12524-12528.
$Fe_{28}Pt_{38}Pd_{34}$ NWs	0.4887		0.1M $HClO_4$+ 0.2 M Methanol	*J. Am. Chem. Soc.* **2012**, 51, 15354-15357.
Pt_7Ru_2Fe NWs		2.27	0.1 M $HClO_4$ + 0.5 M Methanol	*Energy Environ. Sci.* **2015,** 8, 350-363.
PtPb CNCs	0.97	2.09	0.1 M $HClO_4$ +0.5 M Methanol	*Chem. Mater.* **2017**, 29, 4557-4562