Supporting Information for

Rational Design of Multi-site Trielement Ru-Ni-Fe Alloy Nanocatalyst with Efficient and Durable Catalytic Hydrogenation Performance

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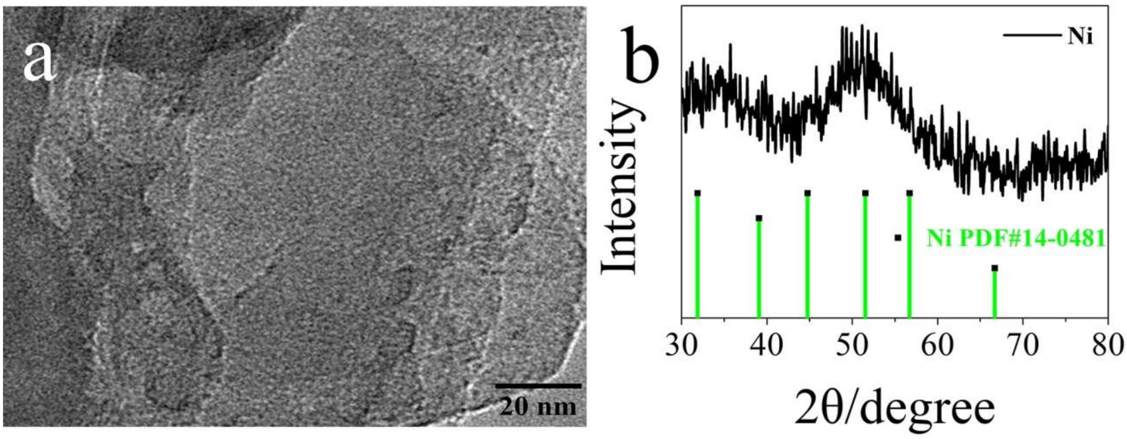

Figure S1. a) TEM images of Ni NPs. b) The XRD pattern of Ni NPs.

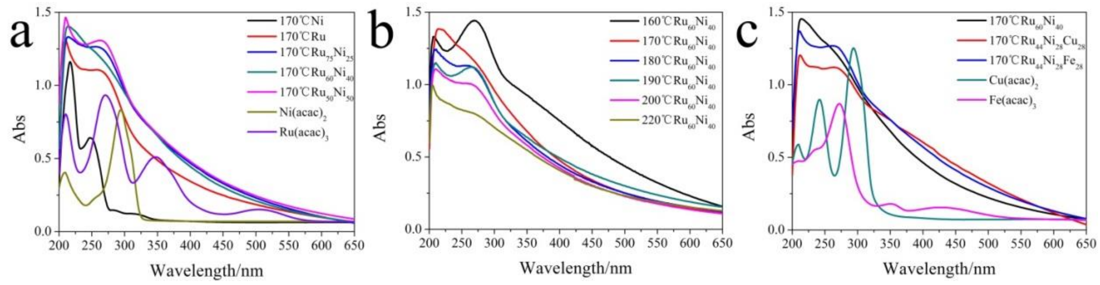

Figure S2. a) UV–vis spectra of prepared Ni NPs, Ru NPs, $Ru_{75}Ni_{25}$ NPs, $Ru_{60}Ni_{40}$ NPs, $Ru_{50}Ni_{50}$ NPs, $Ni(acac)_2$ and $Ru(acac)_3$. b) UV–vis spectra of prepared 160^{0}C $Ru_{60}Ni_{40}$ NPs, 170^{0}C $Ru_{60}Ni_{40}$ NPs, 180^{0}C $Ru_{60}Ni_{40}$ NPs, 190^{0}C $Ru_{60}Ni_{40}$ NPs, 200^{0}C $Ru_{60}Ni_{40}$ NPs and 220^{0}C $Ru_{60}Ni_{40}$ NPs. c) UV–vis spectra of prepared $Ru_{60}Ni_{40}$ NPs, $Ru_{44}Ni_{28}Cu_{28}$ NPs, $Ru_{44}Ni_{28}Fe_{28}$ NPs, $Cu(acac)_2$ and $Fe(acac)_3$.

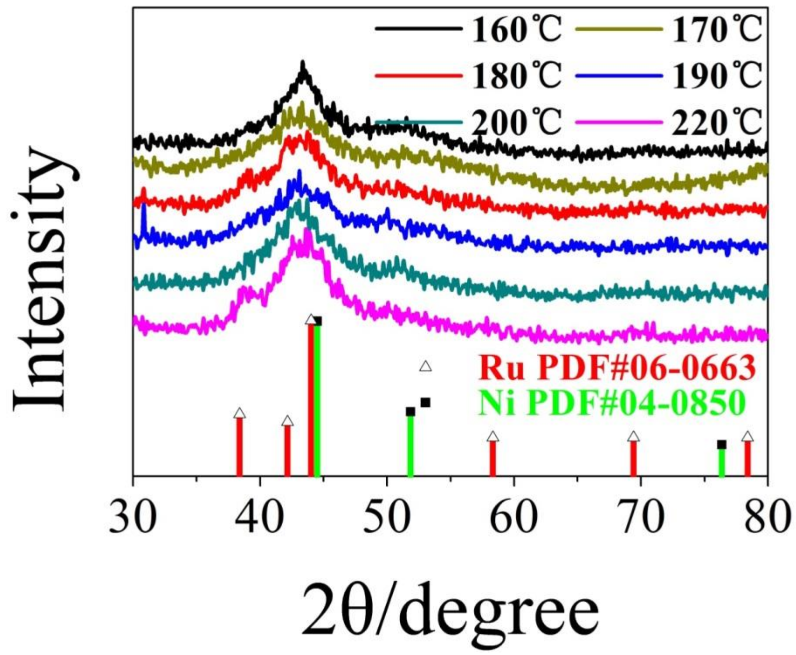

Figure S3. The XRD pattern of $Ru_{60}Ni_{40}$ alloy NPs prepared at different temperatures.

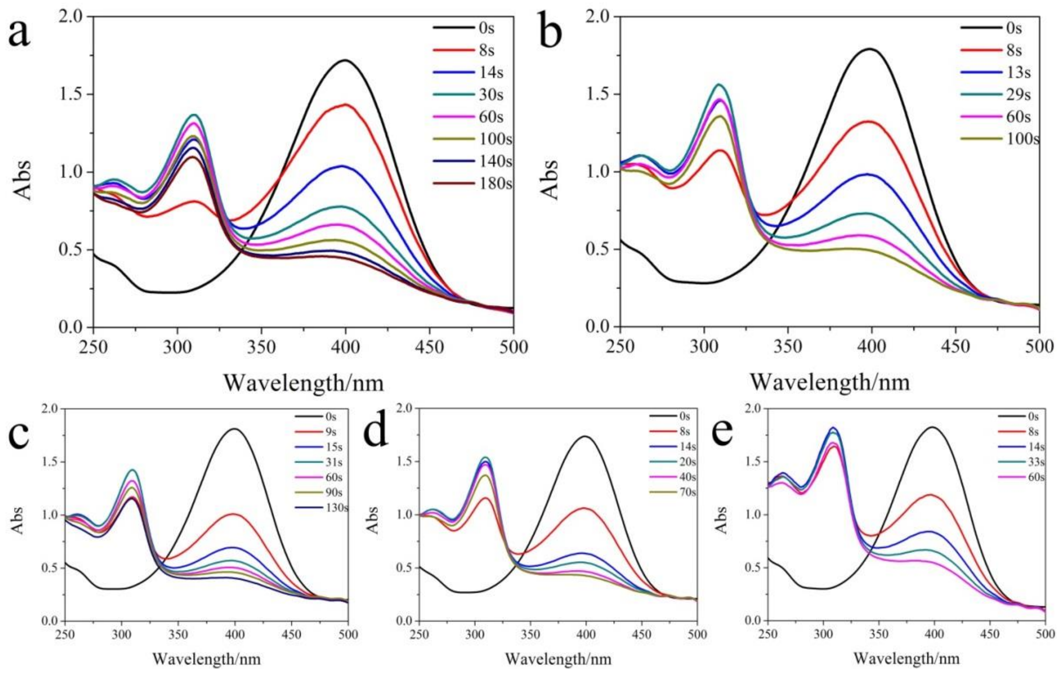

Figure S4. Time-dependent UV–vis spectra of p-NP catalyzed by $Ru_{60}Ni_{40}$ alloy NPs prepared at different temperatures; a) 160^0C $Ru_{60}Ni_{40}$, b) 180^0C $Ru_{60}Ni_{40}$, c) 190^0C $Ru_{60}Ni_{40}$, d) 200^0C $Ru_{60}Ni_{40}$, e) 220^0C $Ru_{60}Ni_{40}$.

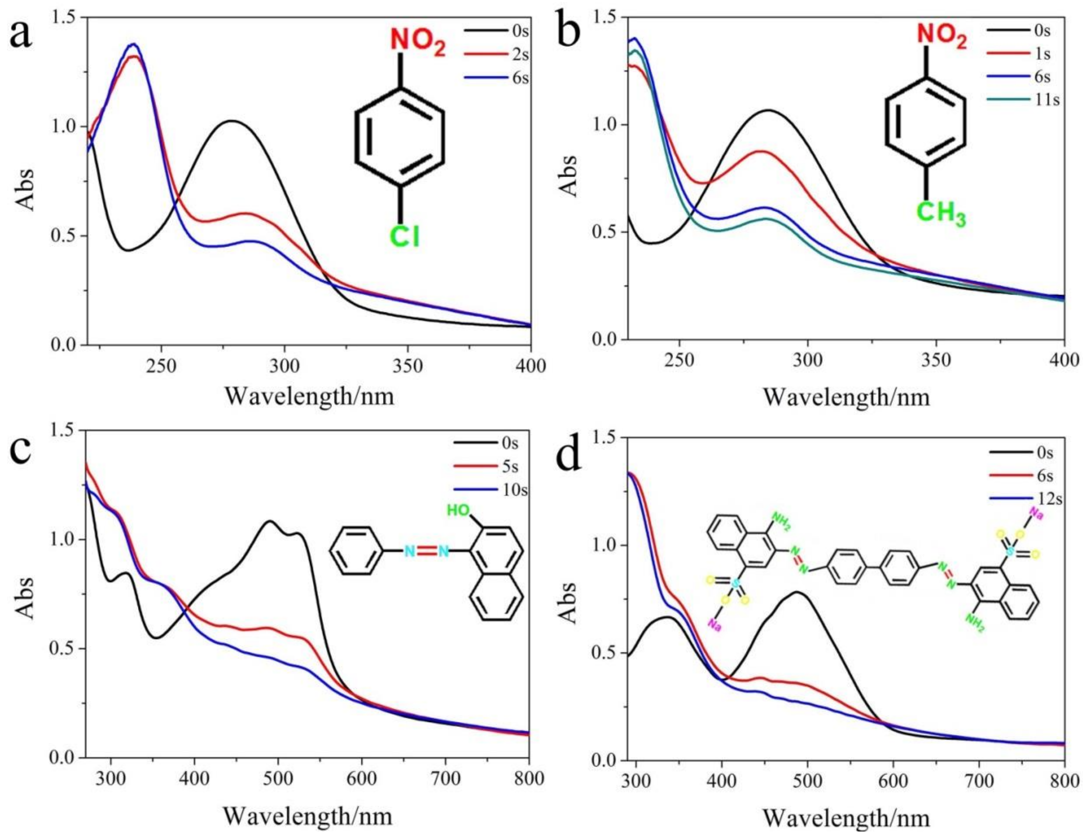

Figure S5. a-d) Time-dependent UV–vis spectra of nitro compounds and azo dyes catalyzed by $Ru_{44}Ni_{28}Fe_{28}$ alloy NPs; a) p-NCB, b) p-NT, c) sudan red 1, d) congo red.

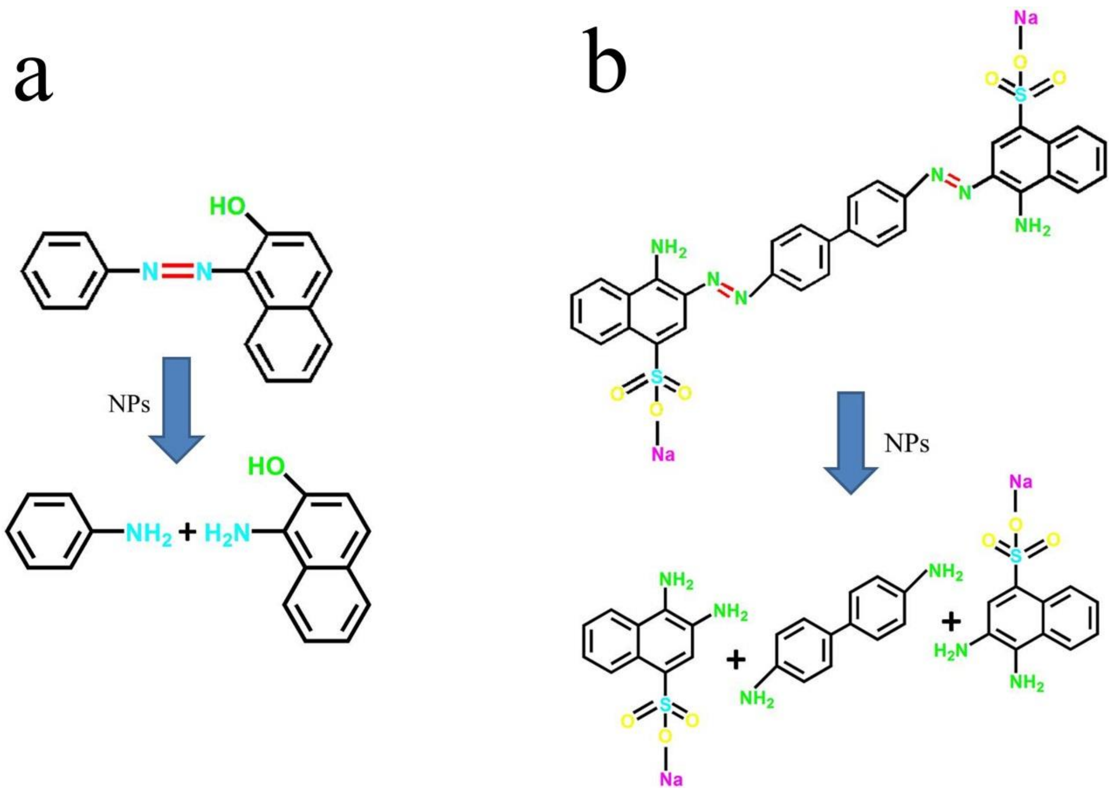

Figure S6. The mechanism of the degradation of azo dyes in the presence of $Ru_{44}Ni_{28}Fe_{28}$ alloy NPs; a) sudan red 1, b) congo red.

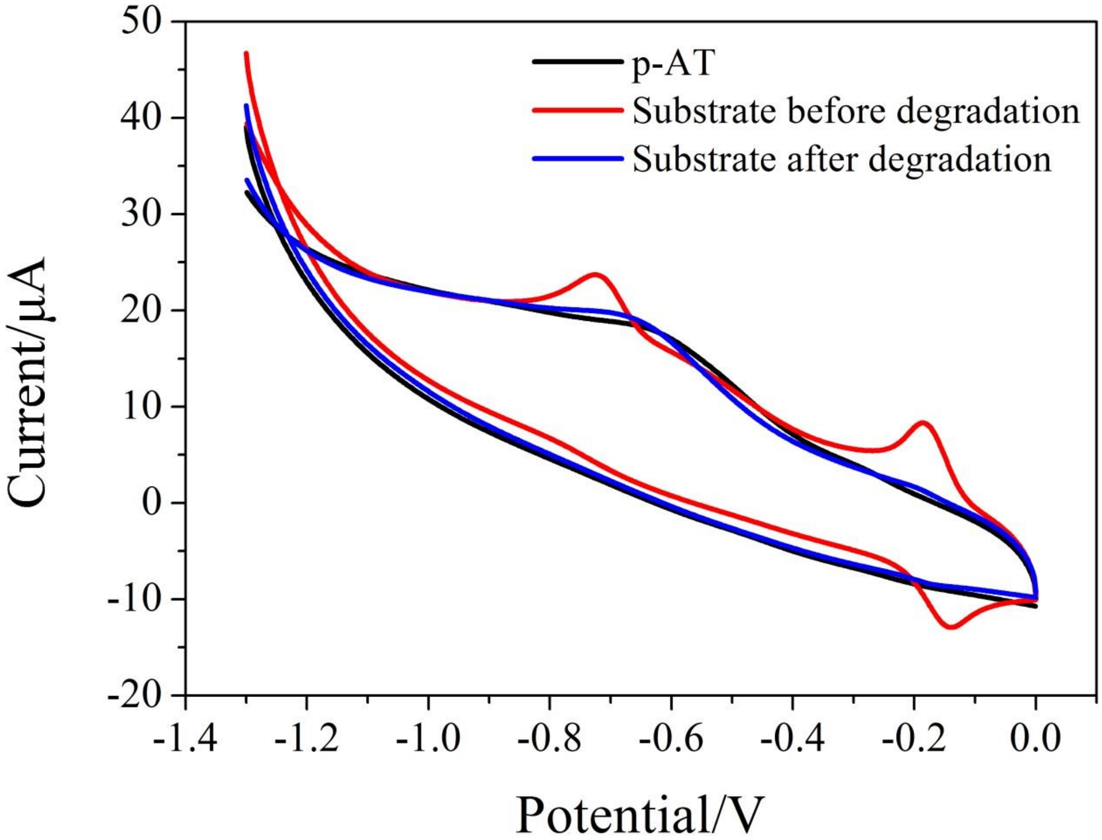

Figure S7. Analysis of catalytic degradation results by CV.

Table S1. Comparison of the catalytic performances of $Ru_{44}Ni_{28}Fe_{28}$ NPs for degradation of p-NP with other catalysts reported in the literatures[a]

Catalyst	m $_{Cata}$ (μg)	$M_{p\text{-}NP}$ (mmol)	t (s)	D (%)	Ref
$Ru_{44}Ni_{28}Fe_{28}$	40	2×10^{-4}	7	99.8	This work
Fe_3O_4@C@Au	3000	3×10^{-4}	40	above 90	1
PdCo@HZIF-400	29	17.3×10^{-4}	120	—	2
$Cu_{0.34}Co_{0.66}$–CeO_2–Pt	100	2×10^{-4}	190	99.2	3
Ni-Ca-Al_2O_3	10000	240×10^{-4}	1080	98.7	4
Ni@Pd/KCC-1	400	3×10^{-4}	290	99.8	5
NG	137	5×10^{-4}	1260	—	6

[a] m $_{Cata}$: mass of catalyst; M $_{p\text{-}NP}$: mole of p-NP; t: degradation time; D: degradation rate.

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