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Supporting Information

Preparing Magnetic Multicomponent Catalysts via the Bio-inspired Assembly For Heterogeneous Reactions

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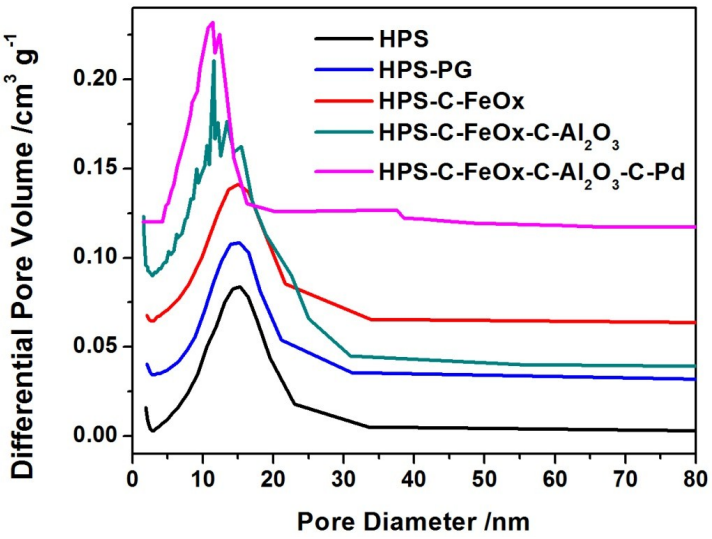

Fig. S1 Pore size distribution before and after the modification of the HPS.

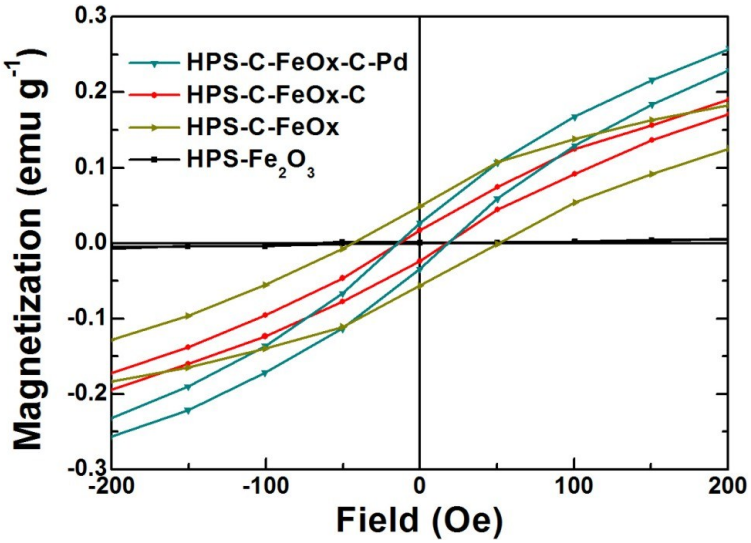

Fig. S2. The expanded low field magnetization curves of Fig. 7.

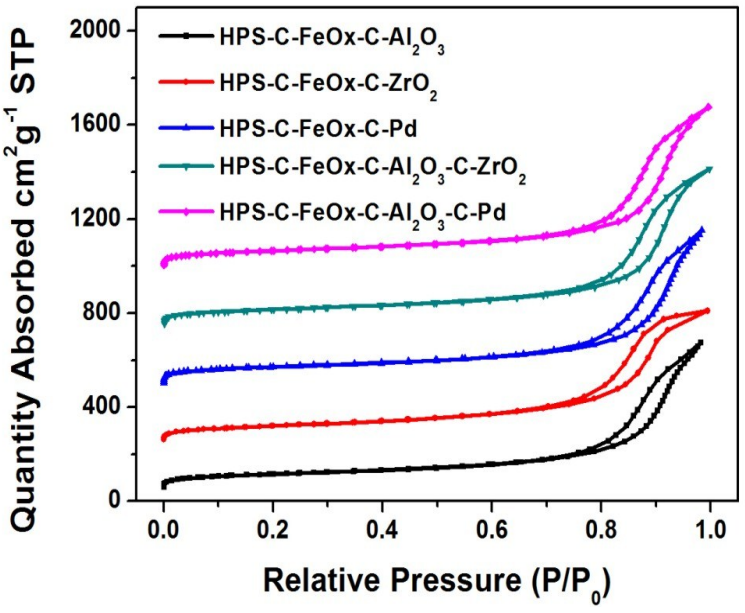

Fig. S3. The N_2 sorption isotherms of the catalysts.

Table S1. Structural properties of bi- and multi-functional catalysts based on the magnetic carrier.

Sample	S_{BET} (m^2 g^{-1})	D_p (nm)	V_p (cm^3 g^{-1})
HPS-C-FeOx-C-Al_2O_3	234.61	12.64	1.021
HPS-C-FeOx-C-ZrO_2	232.36	11.07	0.932
HPS-C-FeOx-C-Pd	243.58	12.60	1.058
HPS-C-FeOx-C-Al_2O_3-C-ZrO_2	236.05	11.15	1.079
HPS-C-FeOx-C-Al_2O_3-Pd	235.76	11.51	1.108

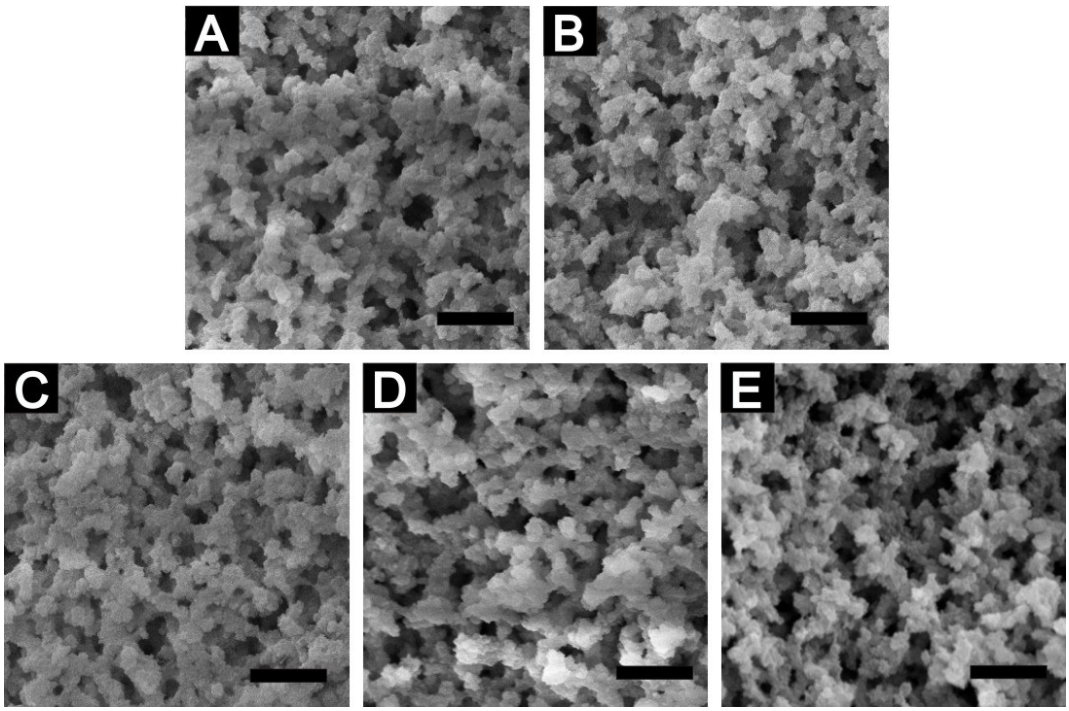

Fig. S4. SEM images of bi- and multi-functional catalysts based on the magnetic carrier (A) HPS-C-FeOx-C-Al_2O_3, (B) HPS-C-FeOx-C-ZrO_2, (C) HPS-C-FeOx-C-Pd, (D) HPS-C-FeOx-C-Al_2O_3-C-ZrO_2 and (E) HPS-C-FeOx-C-Al_2O_3-C-Pd. The scale bars in all the images represent 10 μm.

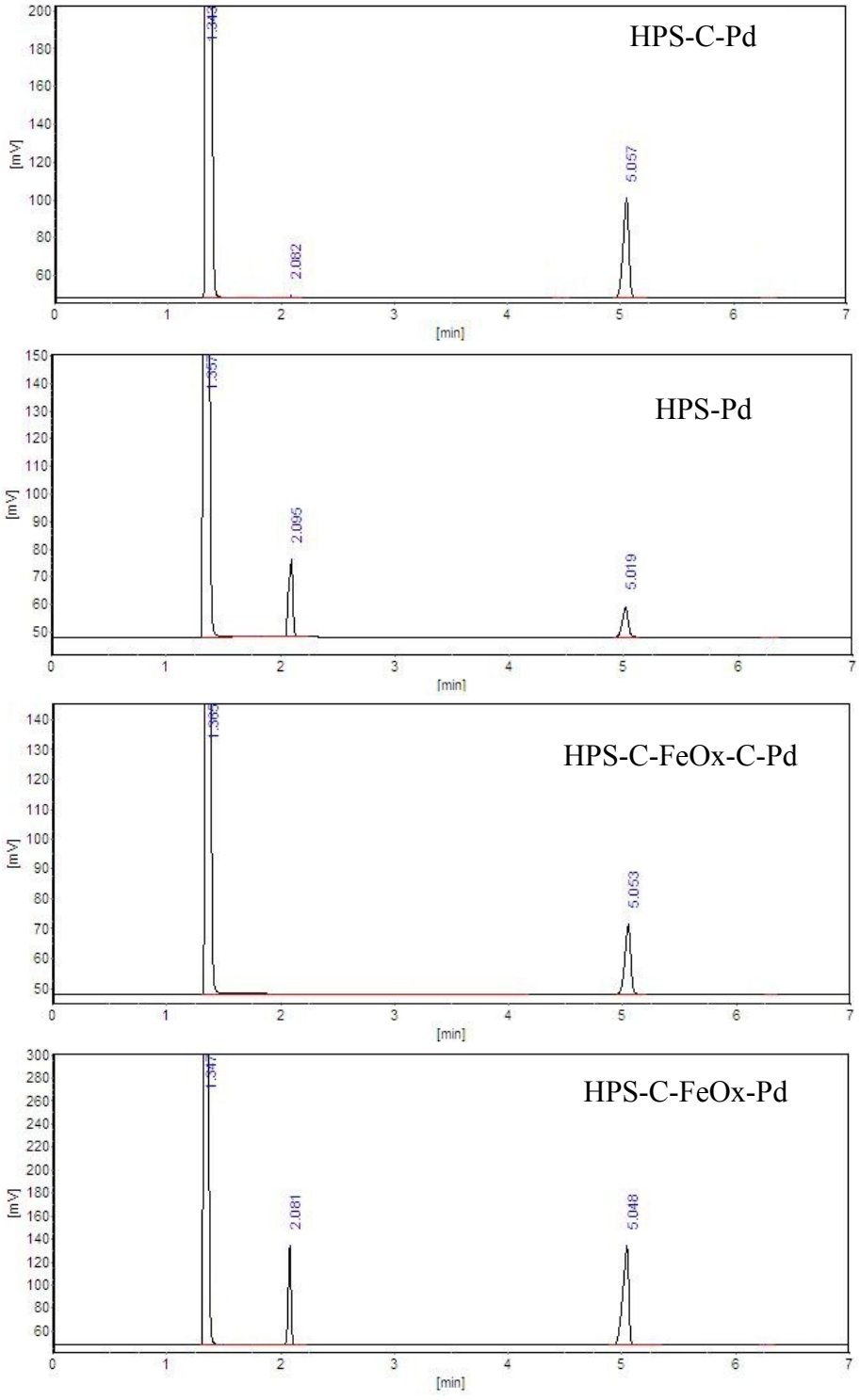

Fig. S5. GC results of different Pd catalysts in the Suzuki-Miyaura coupling reaction of iodobenzene and phenylboronic acid. Peak position at 1.3 min is solvent ethyl alcohol, 2.0 min is iodobenzene and 5.0 min is the product biphenyl. It is seen that the PG coating catalyst represents a novel approach to achieving the high iodobenzene conversion.

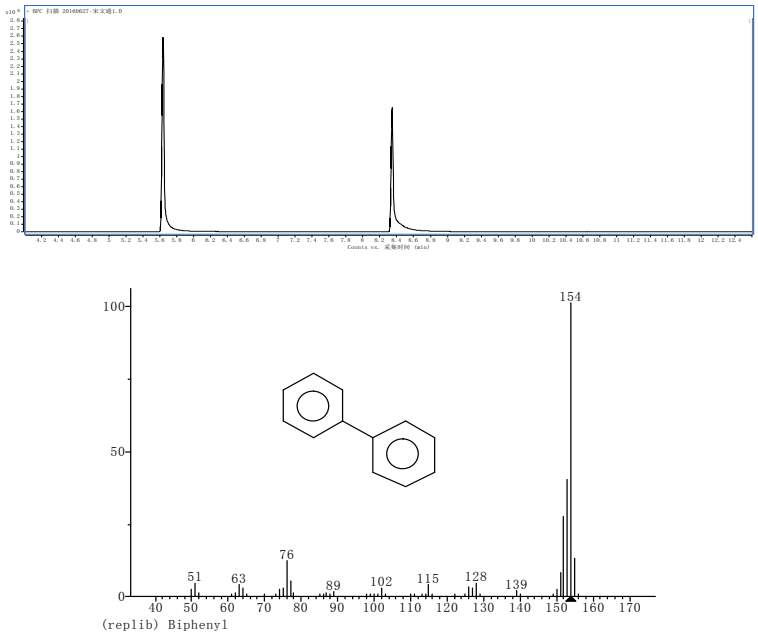

Fig. S6. GC-MS results of Pd catalysts in the Suzuki-Miyaura coupling reaction of iodobenzene and phenylboronic acid. Peak position at 5.6 min is solvent ethyl alcohol and 8.4 min is the product biphenyl.

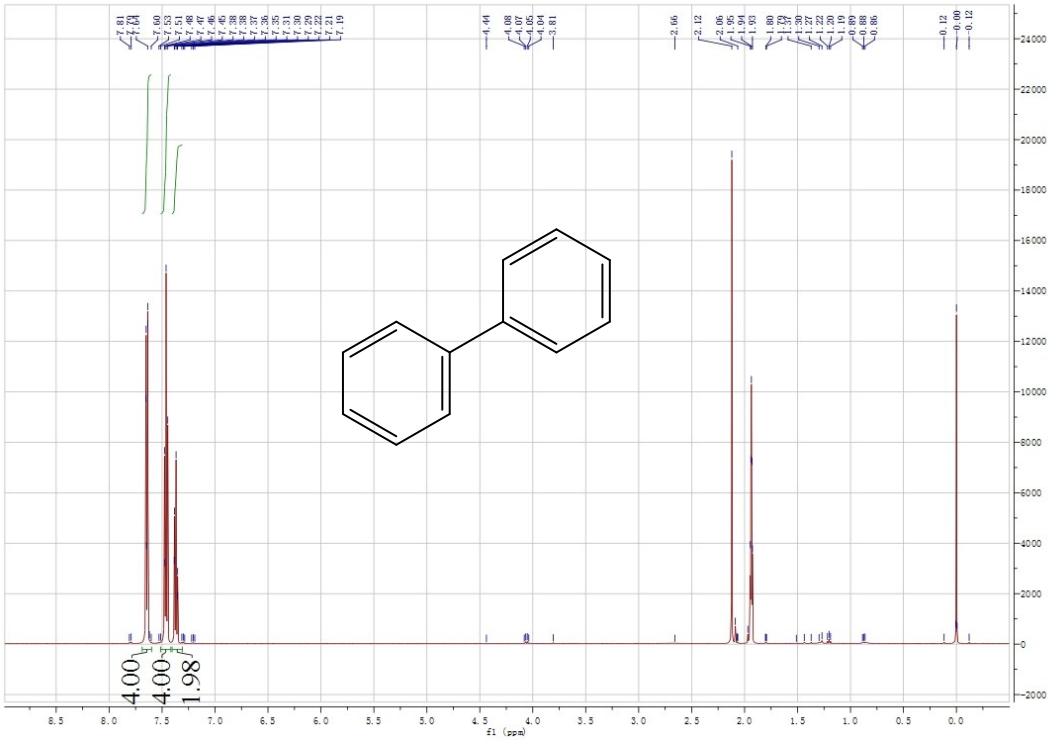

Fig. S7. ^{1}H NMR spectrum results the Suzuki-Miyaura coupling reaction product of biphenyl. Peak position at 1.94 min is the solvent residual peak and at 2.13 min is H_2O peak.

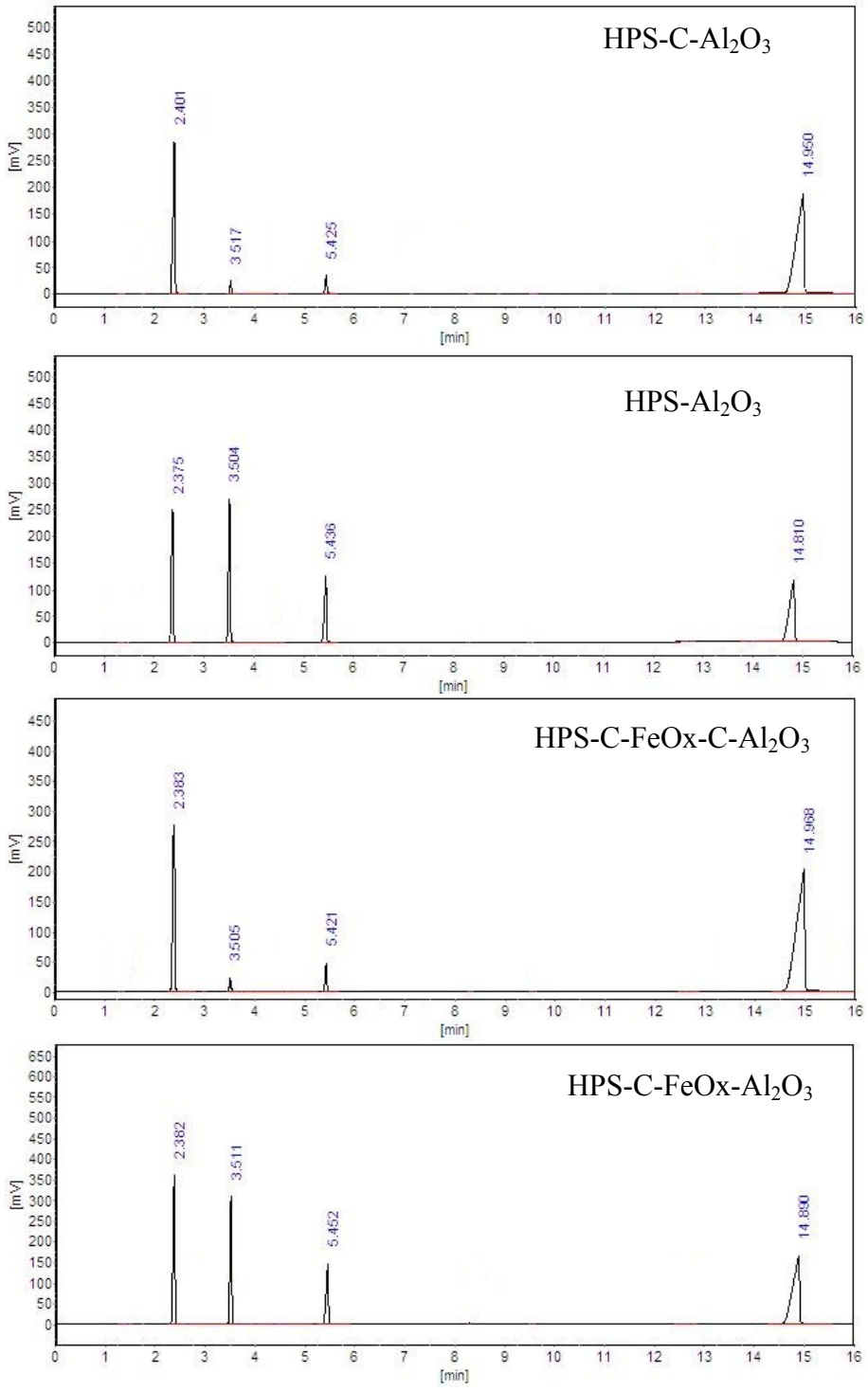

Fig. S8. GC results of different Al_2O_3 catalysts in the Knoevenagel condensations of benzaldehyde and ethyl cyanoacetate. Peak position at 2.3 min is solvent DMF, 3.5 min is benzaldehyde, 5.4 min is ethyl cyanoacetate and the 14.8 min is the product (E)-2-benzylidene-3-oxopentanenitrile. It is seen that the PG coating catalyst represents a novel approach to achieving the high benzaldehyde conversion.

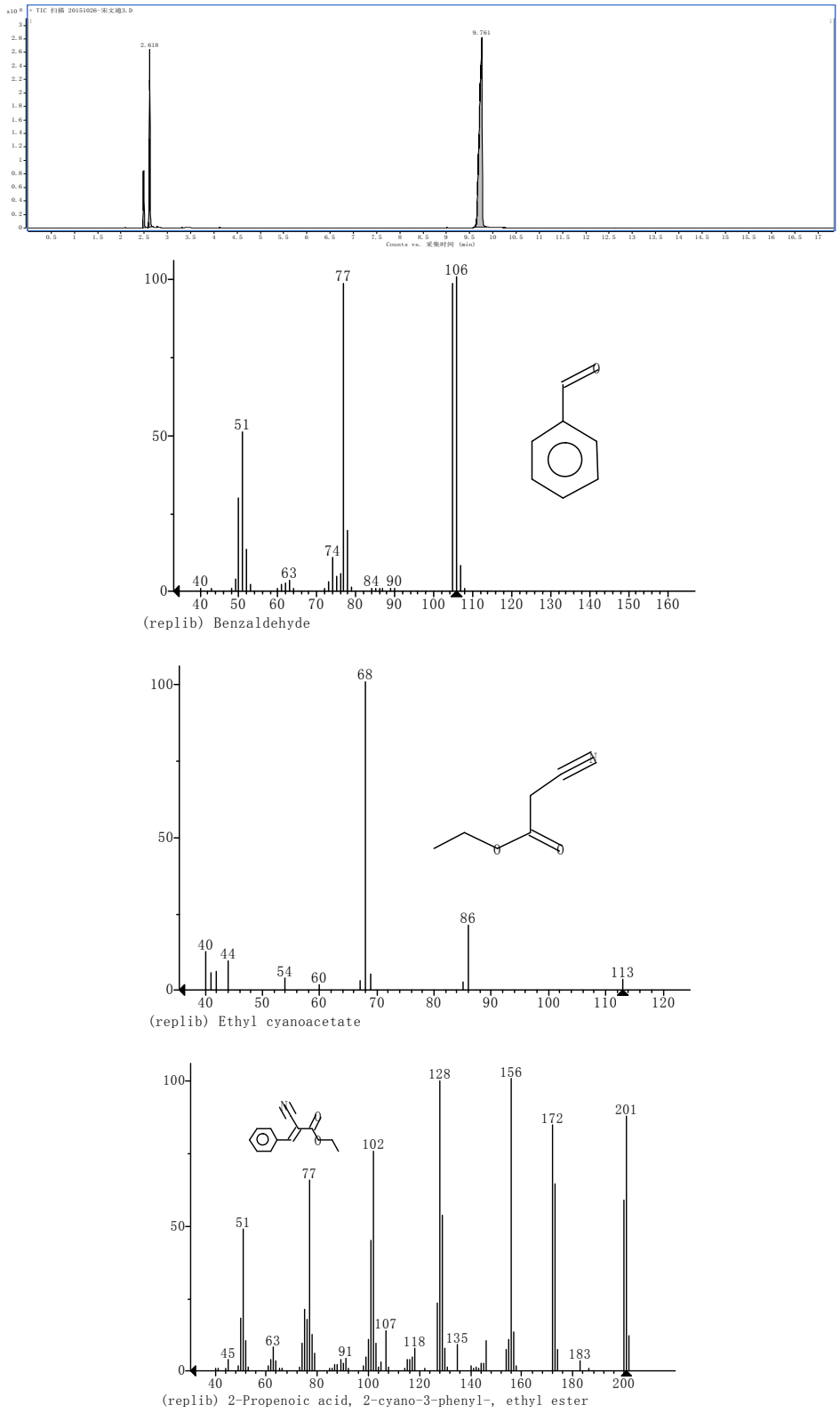

Fig. S9. GC results of different Al_2O_3 catalysts in the Knoevenagel condensations of benzaldehyde and ethyl cyanoacetate. Peak position at 2.48 min is benzaldehyde, 2.62 min is ethyl yanoacetate and the 9.76 min is the product (E)-2-benzylidene-3-oxopentanenitrile.

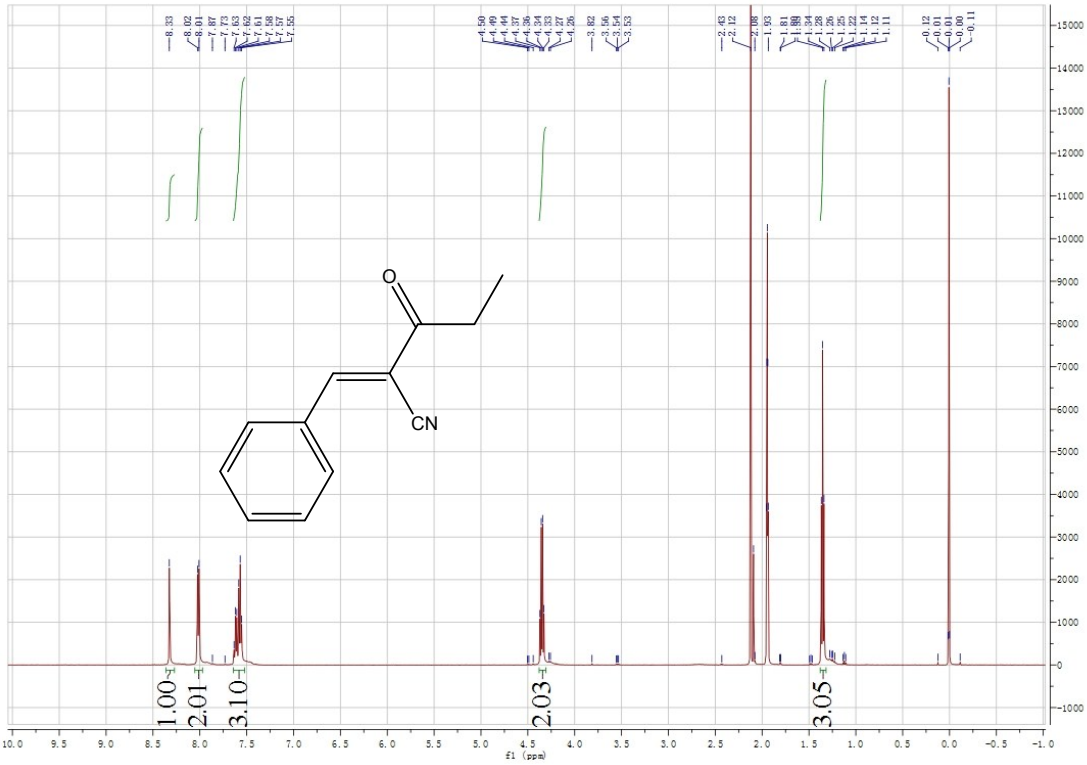

Fig. S10. ^{1}H NMR spectrum results of Al_2O_3 catalysts in the Knoevenagel condensations product of (E)-2-benzylidene-3-oxopentanenitrile. Peak position at 1.94 min is the solvent residual peak and at 2.13 min is H_2O peak.

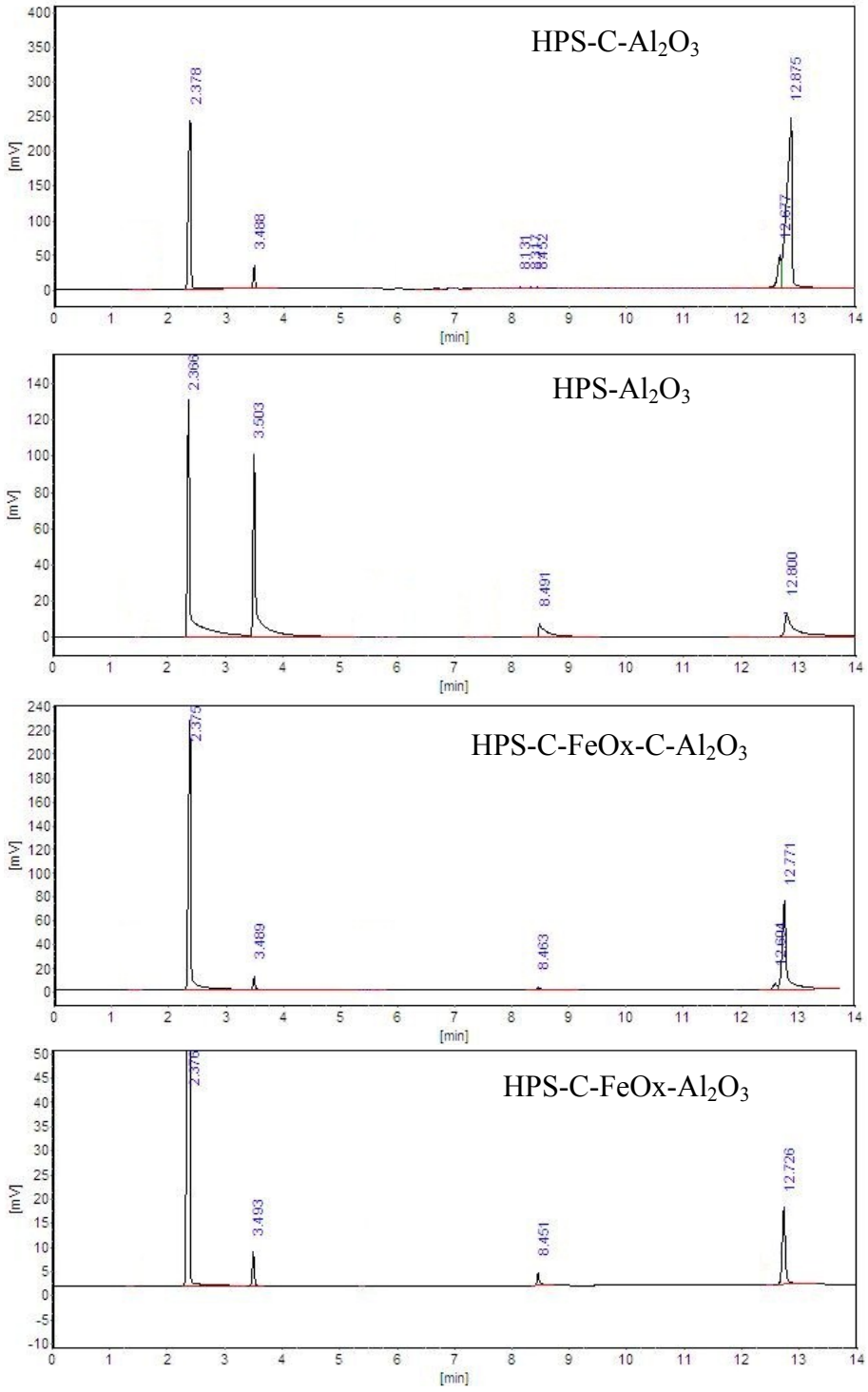

Fig. S11. GC results of different Al_2O_3 catalysts in the Knoevenagel condensations of benzaldehyde and malonitrile. Peak position at 2.3 min is solvent DMF, 3.5 min is benzaldehyde, 8.4 min is malonitrile and the 12.7 min is the product 2-benzylidenemalononitrile. It is seen that the PG coating catalyst represents a novel approach to achieving the high benzaldehyde conversion.

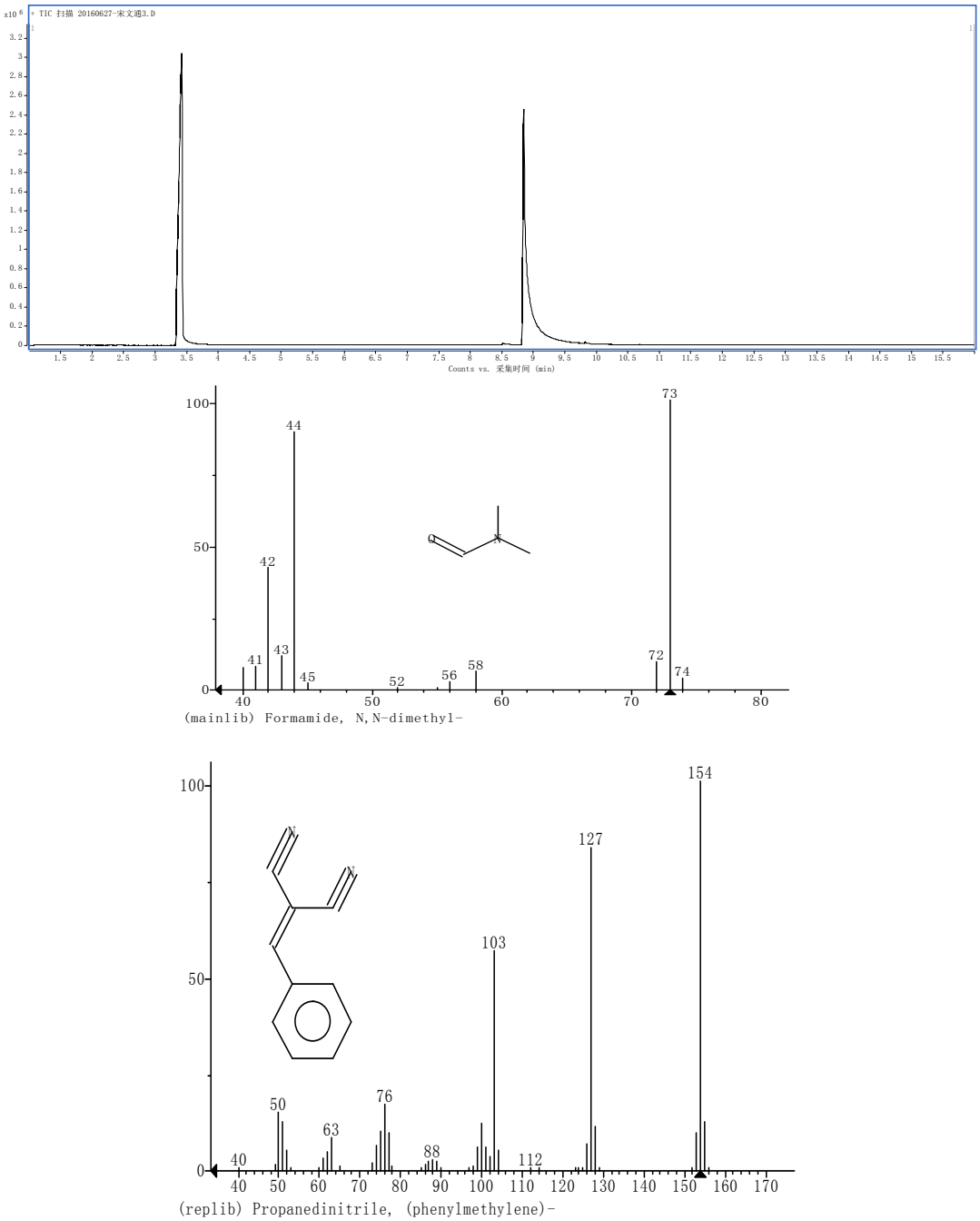

Fig. S12. GC results of different Al_2O_3 catalysts in the Knoevenagel condensations of benzaldehyde and malonitrile. Peak position at 3.4 min is DMF and 8.9 min is the product 2-benzylidenemalononitrile.

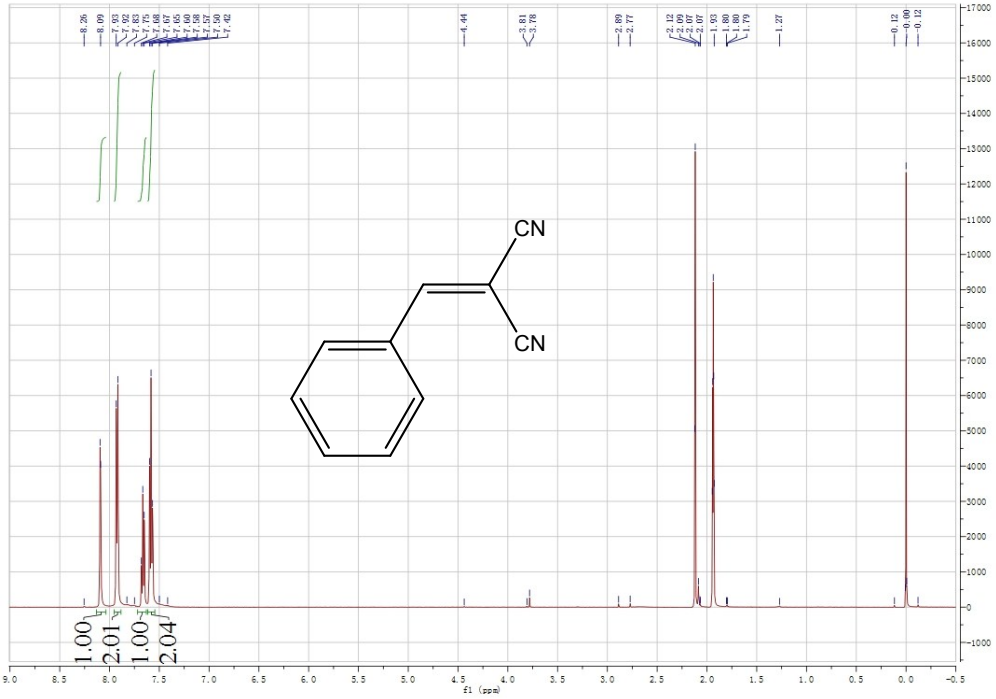

Fig. S13. ^{1}H NMR spectrum results of Al_2O_3 catalysts in the Knoevenagel condensations product of 2-benzylidenemalononitrile. Peak position at 1.94 min is the solvent residual peak and at 2.13 min is H_2O peak.

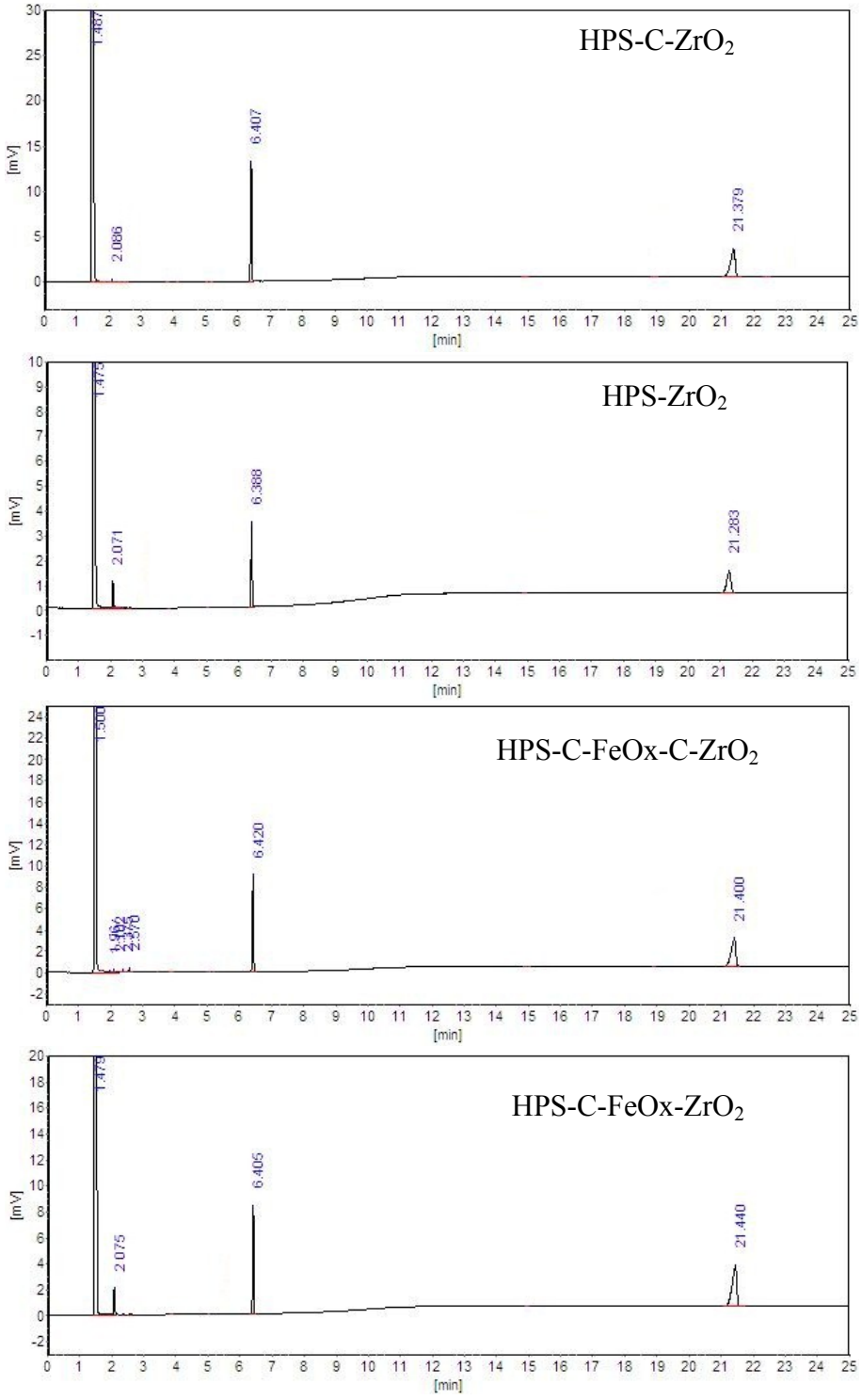

Fig. S14. GC results of different ZrO_2 catalysts in the Friedel-Crafts alkylation of indoles with chalcones. Peak position at 1.4 min is solvent toluene, 2.0 min is indoles, 6.4 min is chalcones and the 21.3 min is the product 3-(1H-indol-3-yl)-1,3-diphenylpropan-1-one. It is seen that the PG coating catalyst represents a novel approach to achieving the high indoles conversion.

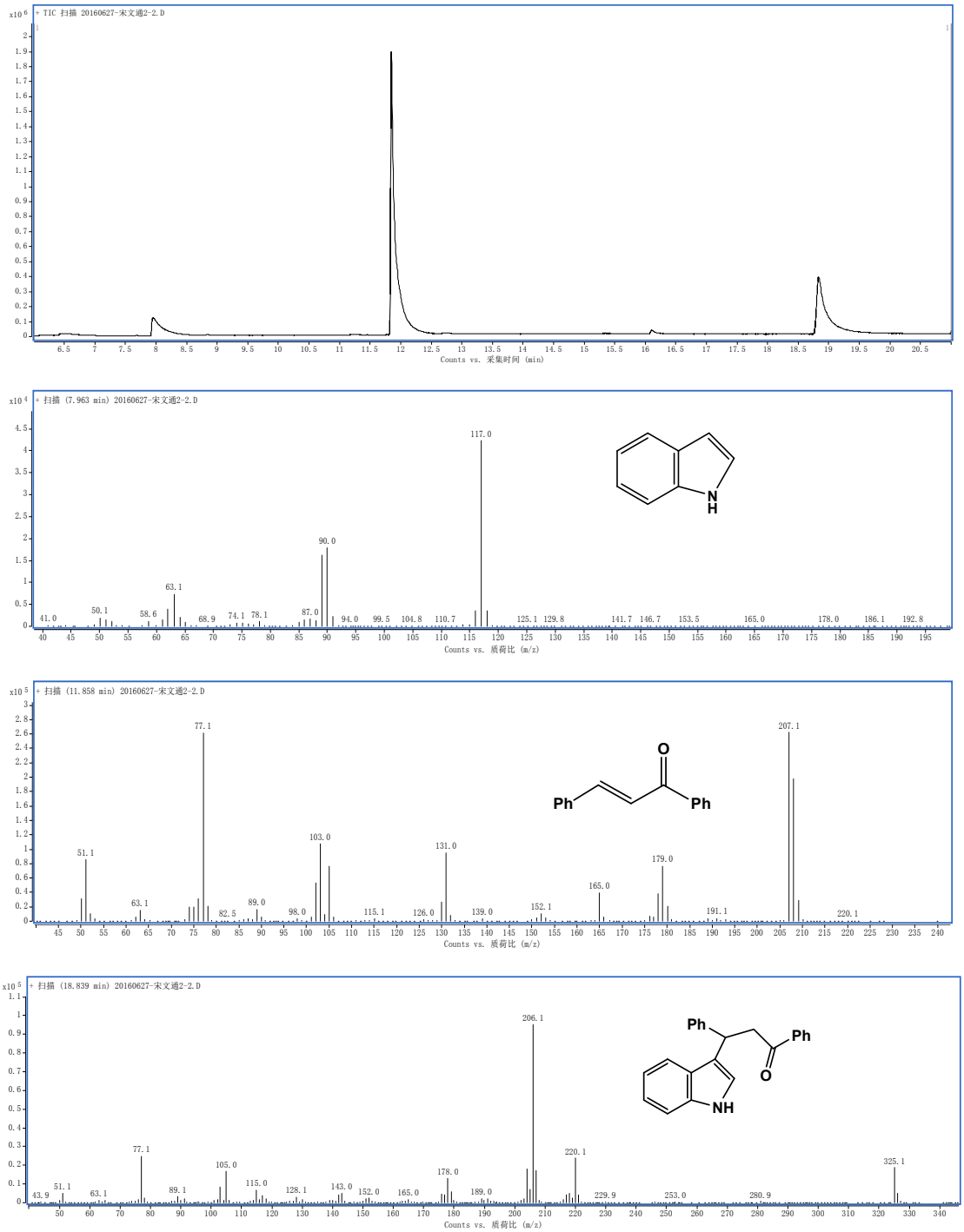

Fig. S15. GC-MS results of different ZrO_2 catalysts in the Friedel−Crafts alkylation of indoles with chalcones. Peak position at 7.9 min is indoles, 11.8 min is chalcones and the 18.8 min is the product 3-(1H-indol-3-yl)-1,3-diphenylpropan-1-one.

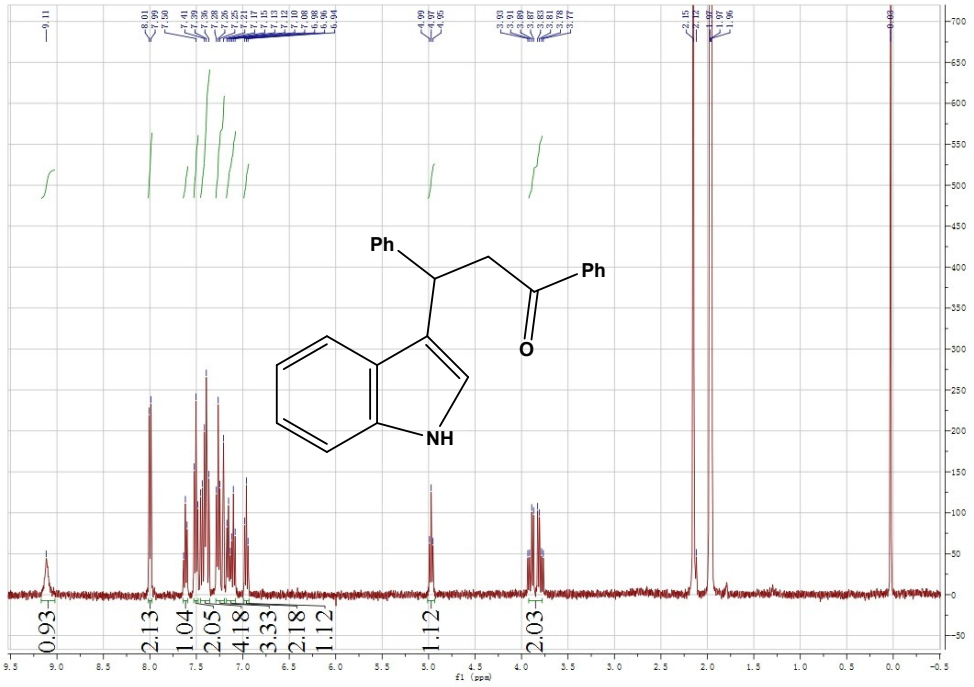

Fig. S16. ^{1}H NMR spectrum results of ZrO_2 catalysts in the Friedel−Crafts alkylation product of 3-(1H-indol-3-yl)-1,3-diphenylpropan-1-one. Peak position at 1.94 min is the solvent residual peak and at 2.13 min is H_2O peak.

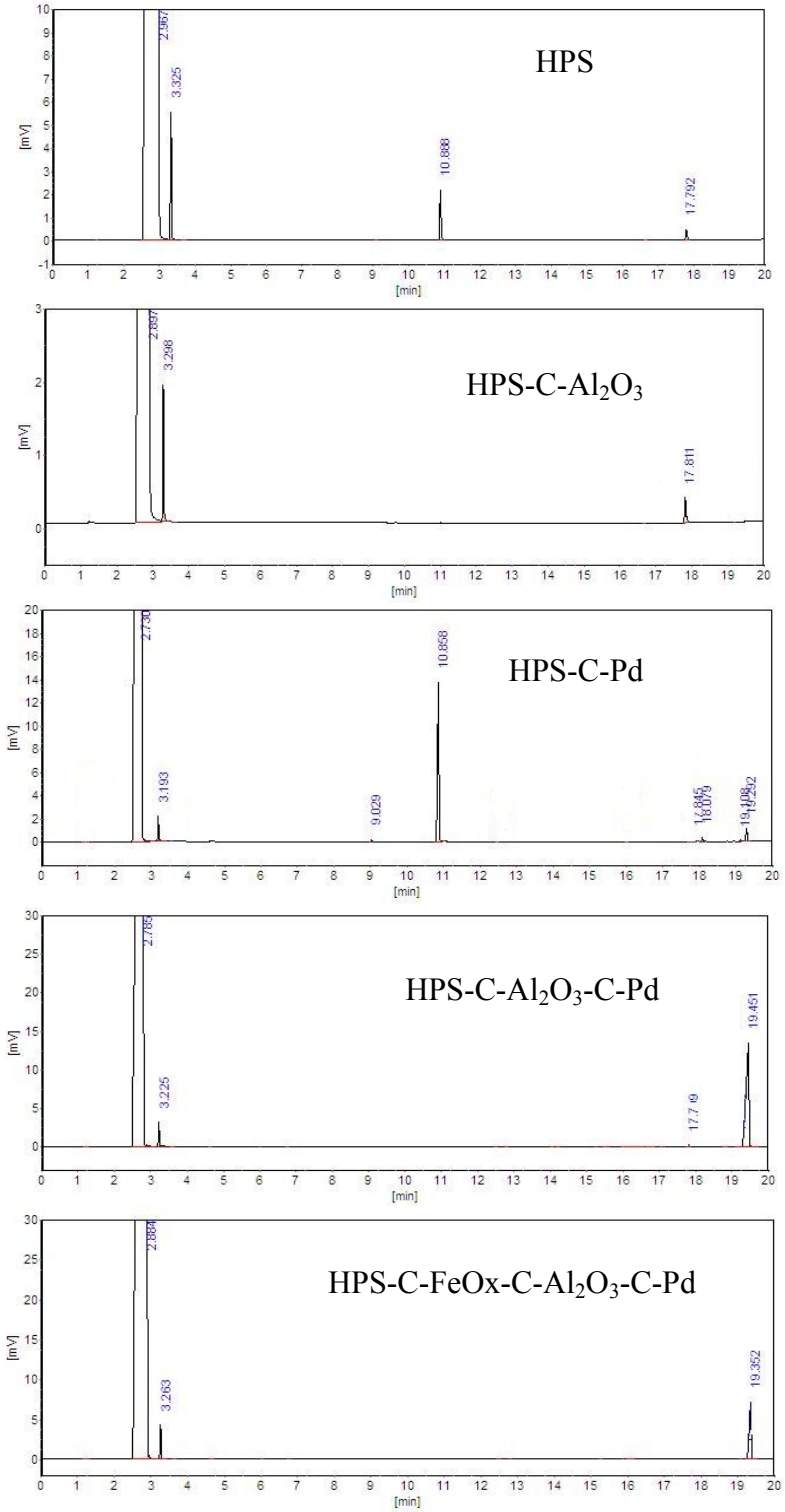

Fig. S17. GC results of one-pot Knoevenagel condensation−hydrogenation multistep cascade reactiontandem. Peak position at 2.8 min is solvent DMF, 3.3 min is malonitrile, 10.8 min is p-nitrobenzaldehyde, 17.7 min is 2-(4-nitrobenzylidene)malononitrile and the 19.4 min is the final

product 2-(4-aminobenzylidene)malononitrile. It is seen that the PG coating nanostructures can catalyzed the cascade reactions completely.

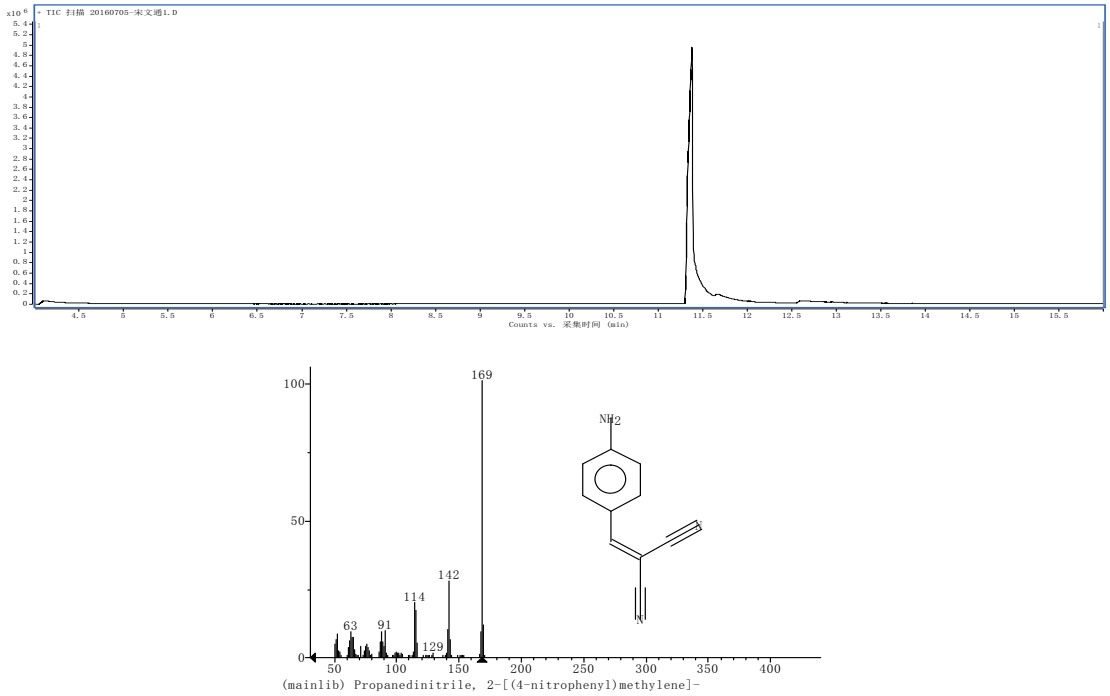

Fig. S18. GC-MS results of the HPS-C-FeOx-C-Al_2O_3-C-Pd multi-functional catalytic one-pot Knoevenagel condensation−hydrogenation multistep cascade reaction. Peak position at 11.4 min is the product 2-(4-aminobenzylidene)malononitrile.

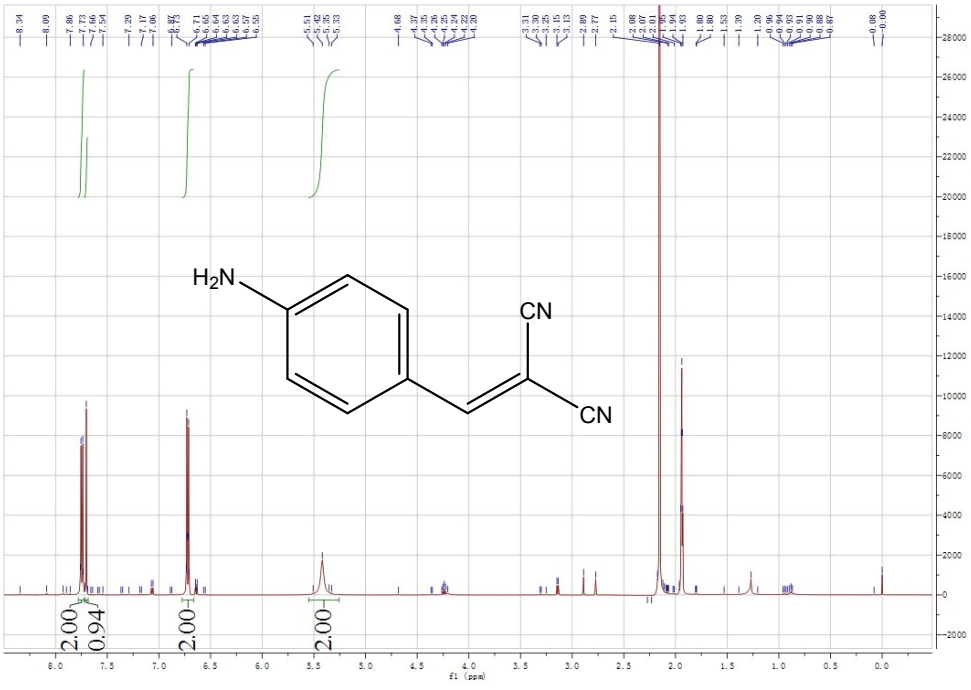

Fig. S19. ^{1}H NMR spectrum results of the HPS-C-FeOx-C-Al_2O_3-C-Pd multi-functional catalytic cascade reaction product 2-(4-aminobenzylidene)malononitrile. Peak position at 1.94 min is the solvent residual peak and at 2.13 min is H_2O peak.

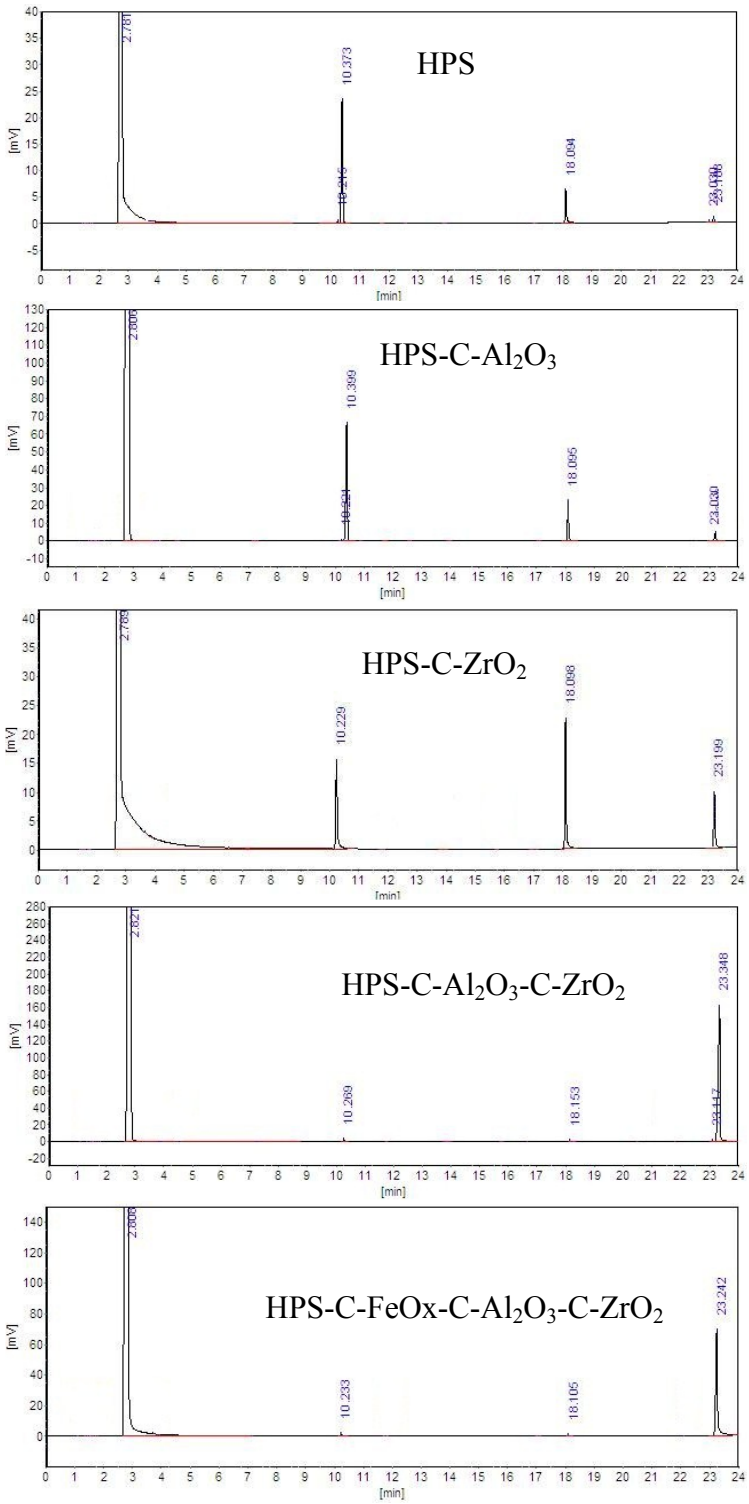

Fig. S20. GC results of one-pot tandem Deacetalization-Knoevenagel condensation cascade reaction. Peak position at 2.78 min is solvent toluene, 10.2 min is benzaldehyde, 10.4 min is benzaldehyde dimethyl acetal, 10.8 min is malonitrile and the 23.1 min is the product 2-benzylidenemalononitrile. It is seen that the PG coating nanostructures can catalyze the cascade reactions completely.

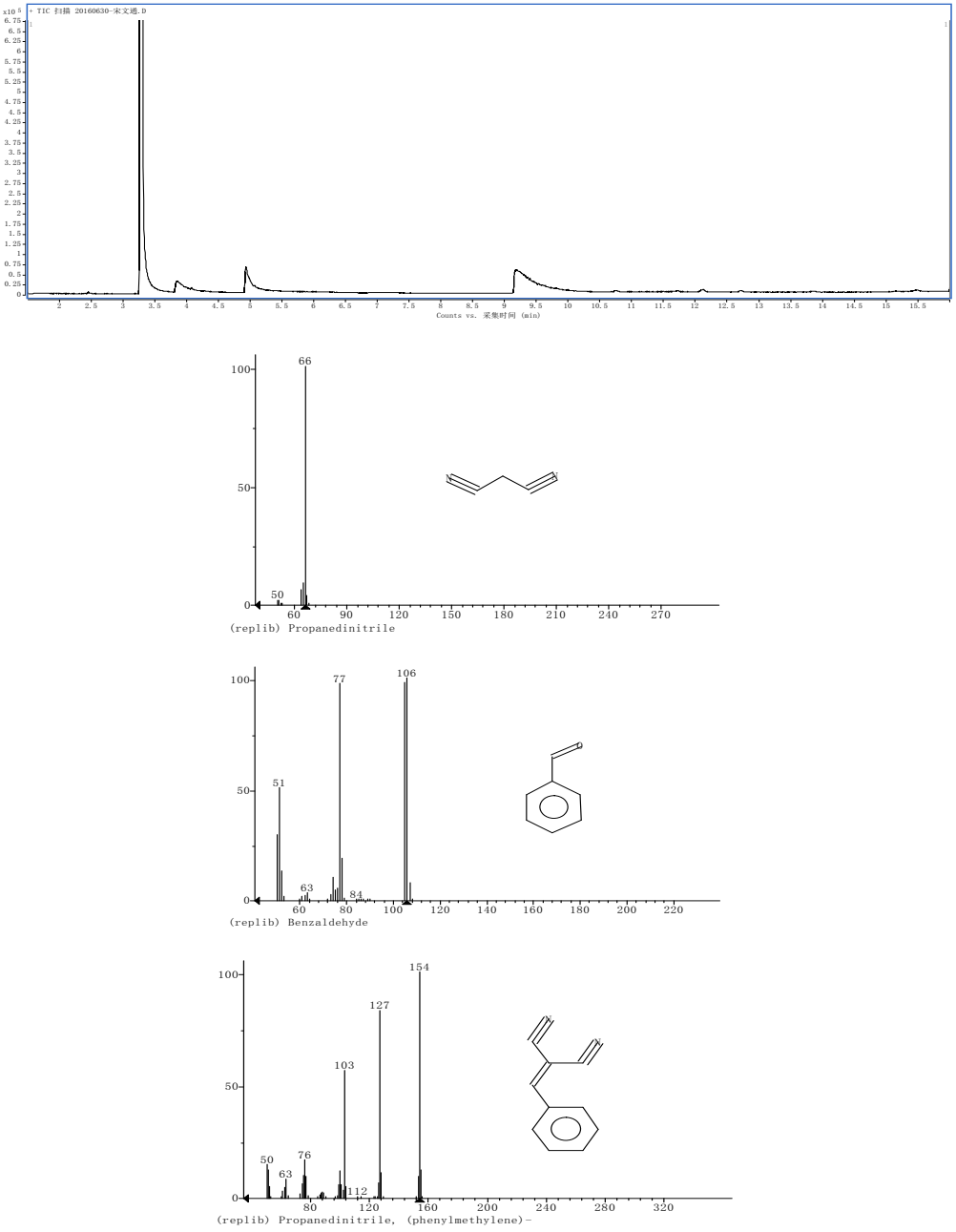

Fig. S21. GC-MS results of the HPS-C-FeOx-C-Al_2O_3-C-ZrO_2 multi-functional catalytic one-pot tandem Deacetalization-Knoevenagel condensation cascade reaction. Peak position at 3.3 min is solvent DMF, 3.8 min is malonitrile, 4.9 min is benzaldehyde and the 9.2 min is the product 2-benzylidenemalononitrile.

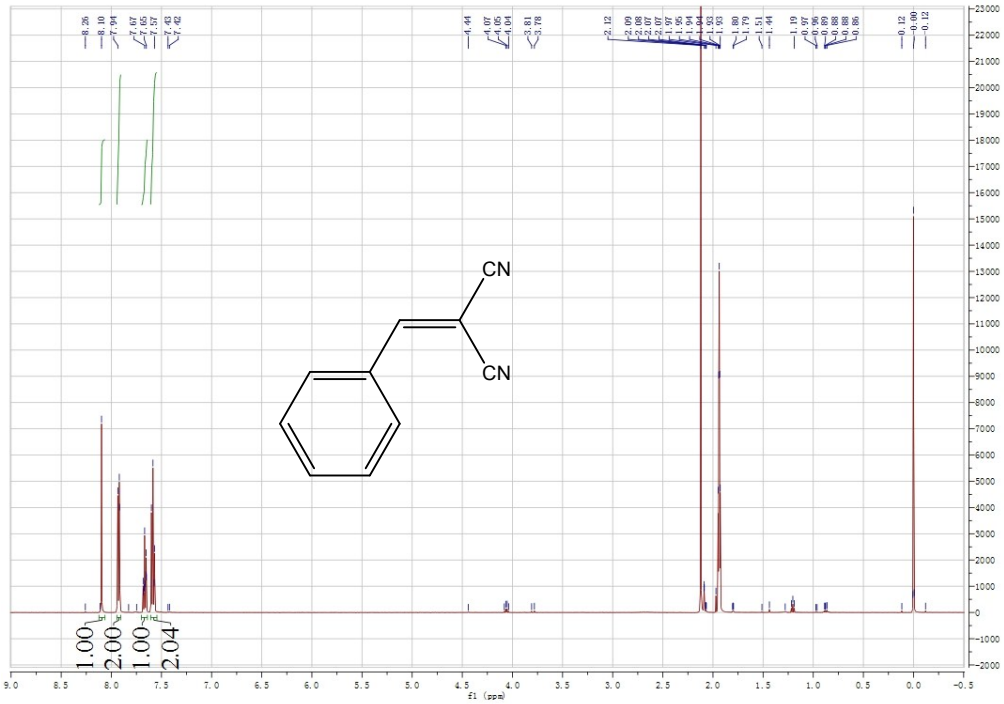

Fig. S22. ^{1}H NMR spectrum results of the HPS-C-FeOx-C-Al_2O_3-C-ZrO_2 multi-functional catalytic cascade reaction product 2-benzylidenemalononitrile. Peak position at 1.94 min is the solvent residual peak and at 2.13 min is H_2O peak.