Electronic Supplementary Material (ESI) for Green Chemistry

SUPPORTING INFORMATION

for manuscript:

An Efficient Cu(II)-bis(oxazoline)-Based Polymer Immobilised Ionic Liquid Phase Catalyst for Asymmetric Carbon-Carbon Bond Fomation

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General Information

Dichloromethane was distilled from calcium hydride under a nitrogen atmosphere. Toluene was distilled from potassium under nitrogen. Diethyl ether was distilled from benzophenone ketyl under nitrogen. NMR experiments were recorded on a Bruker Avance 300 MHz NMR spectrometer using $CDCl_3$ as the solvent. ^{1}H ^{13}C NMR and 19F spectra were conducted at 300, 75 and 282MHz respectively. For SEM examination, samples were mounted upon aluminium stubs with carbon tape and analysed using a FEI Quanta 250 FEG SEM at 20kV. The non-ionic sample (P-7) was coated with Au in order to prevent charging before being mounted on carbon tape. ATR IR spectra were recorded using a Perkin Elmer 100 with a horizontal plate containing a ZnSe crystal. The spectra was recorded with a wavenumber resolution of 4 cm^{-1} following 16 scans accumulated for a single spectrum. The working temperature was 25 ^{o}C. HPLC analysis was conducted using an Agilent 1100 equipped with an UV Diode Array detector.

Contents

Figure S1 ^{1}H NMR spectrum of 1-(4-vinylbenzyl)pyrrolidine (**8**)

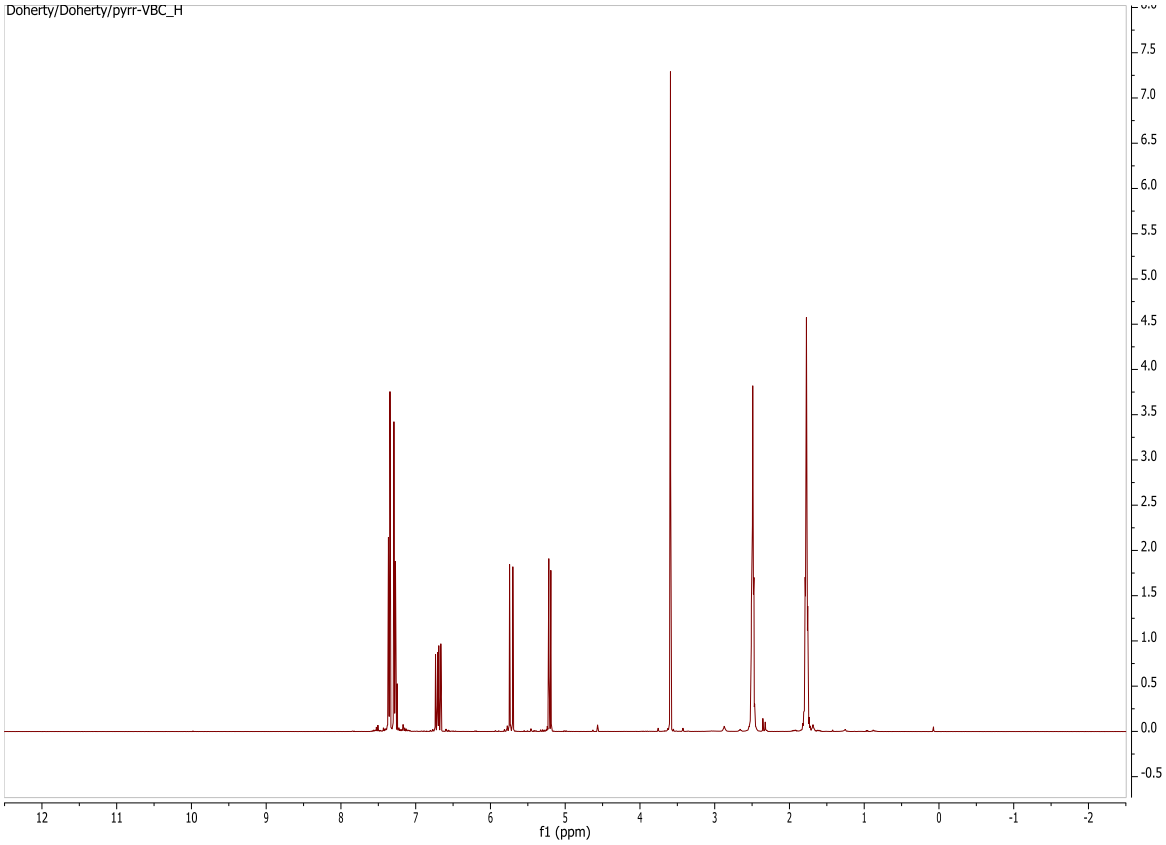

Figure S2 ^{13}C NMR spectrum of 1-(4-vinylbenzyl)pyrrolidine (**8**)

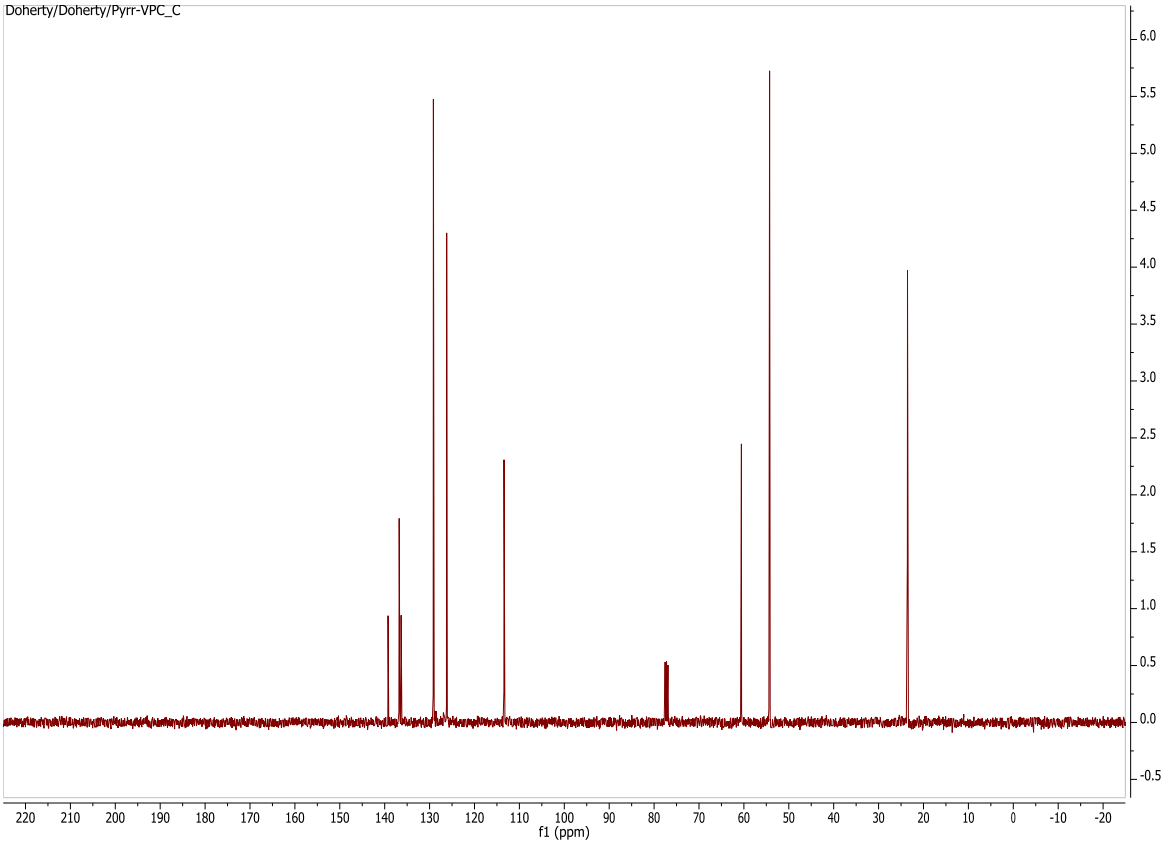

Figure S3 ^{1}H NMR spectrum of 1-benzyl-1-(4-vinylbenzyl)pyrrolidinium bromide (**9.Br**)

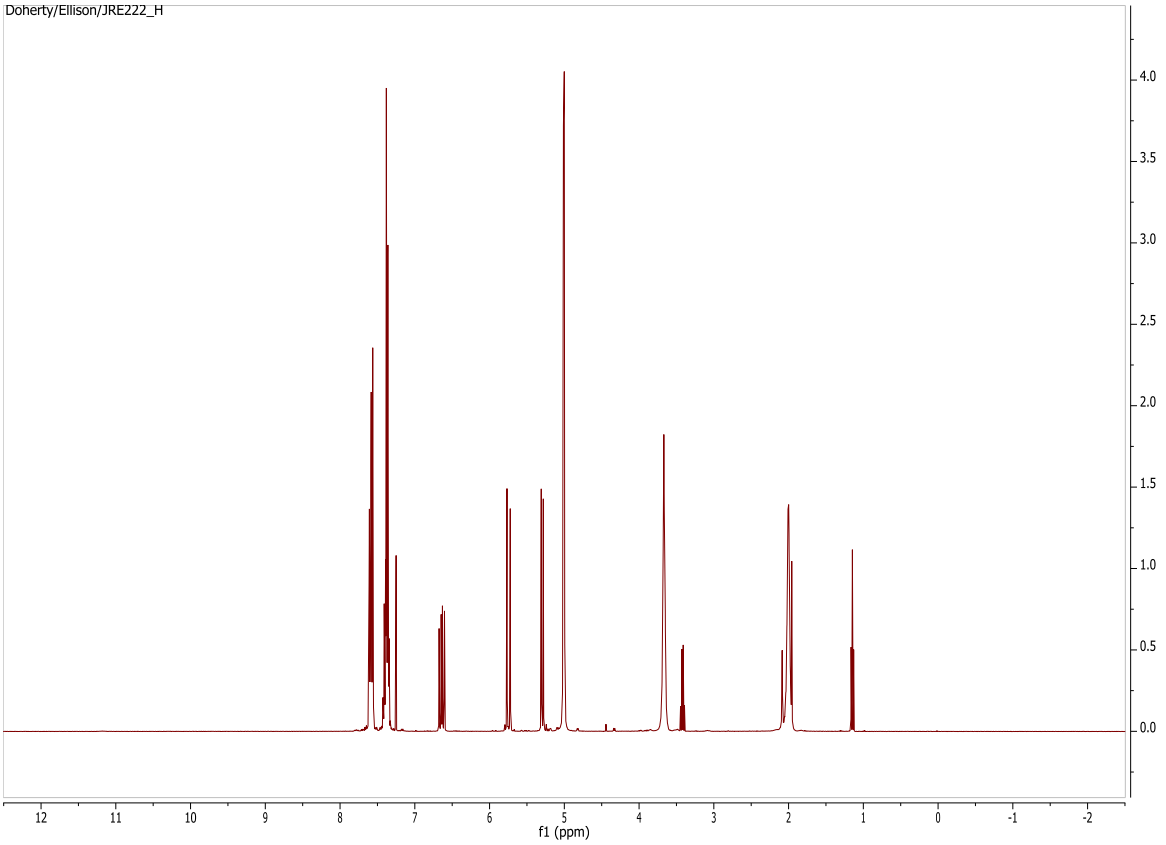

Figure S4 ^{13}C NMR spectrum of 1-benzyl-1-(4-vinylbenzyl)pyrrolidinium bromide (**9.Br**)

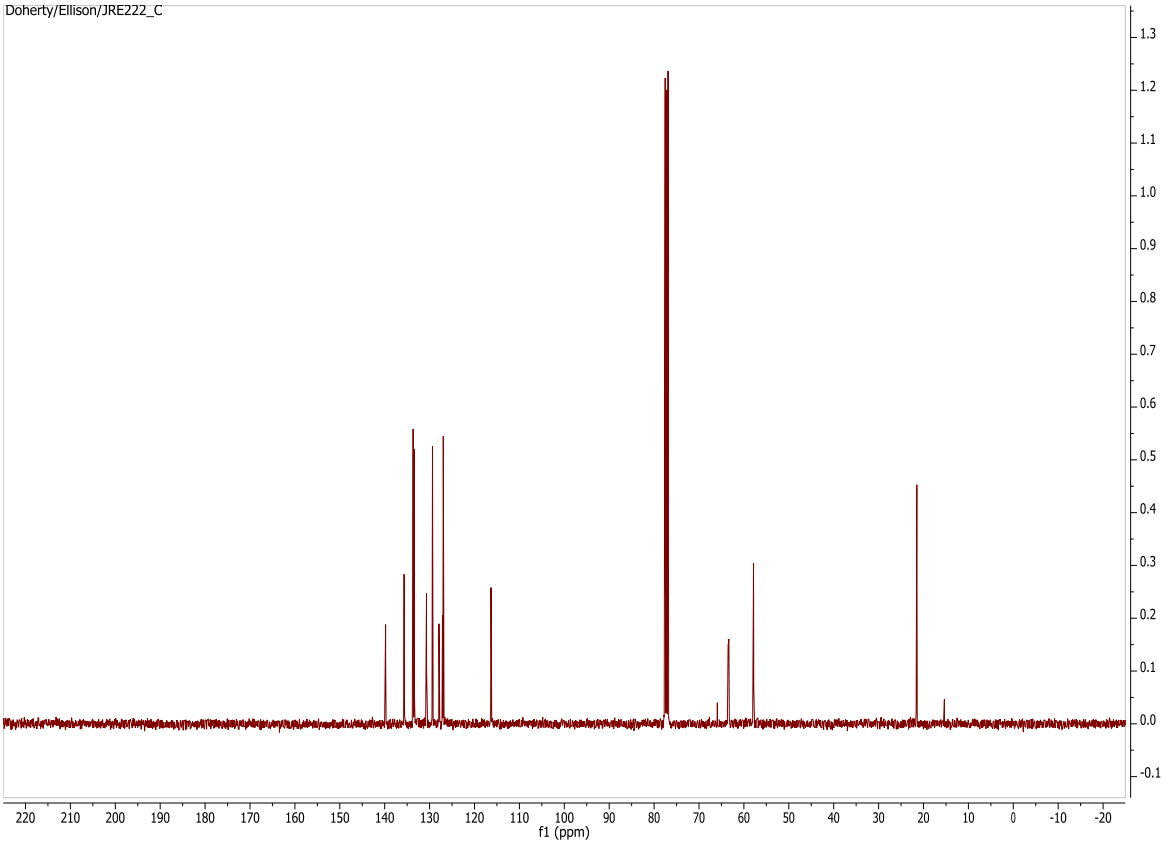

Figure S5 ^{1}H NMR spectrum of 1-benzyl-1-(4-vinylbenzyl)pyrrolidinium bistriflimide (**9.NTf$_2$**)

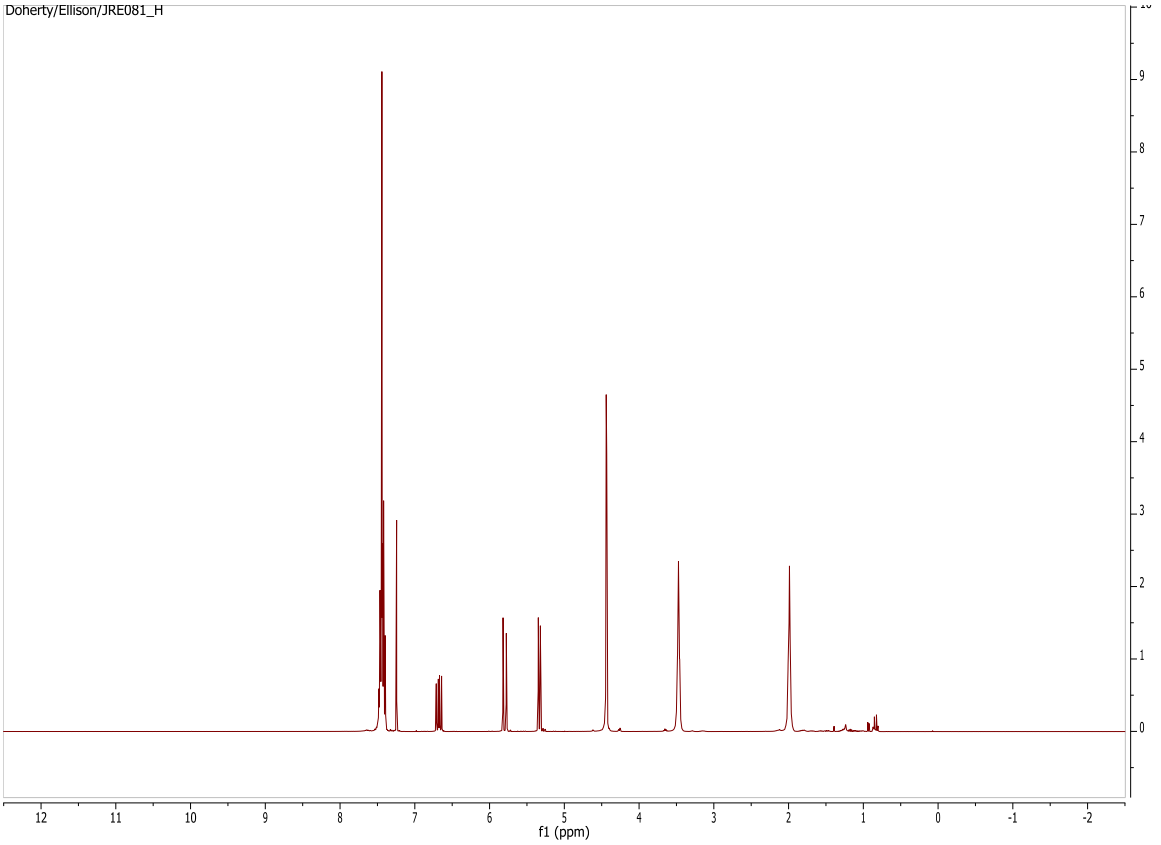

Figure S6 ^{13}C NMR spectrum of 1-venzyl-1-(4-vinylbenzyl)pyrrolidinium bistrifimide (**9.NTf$_2$**)

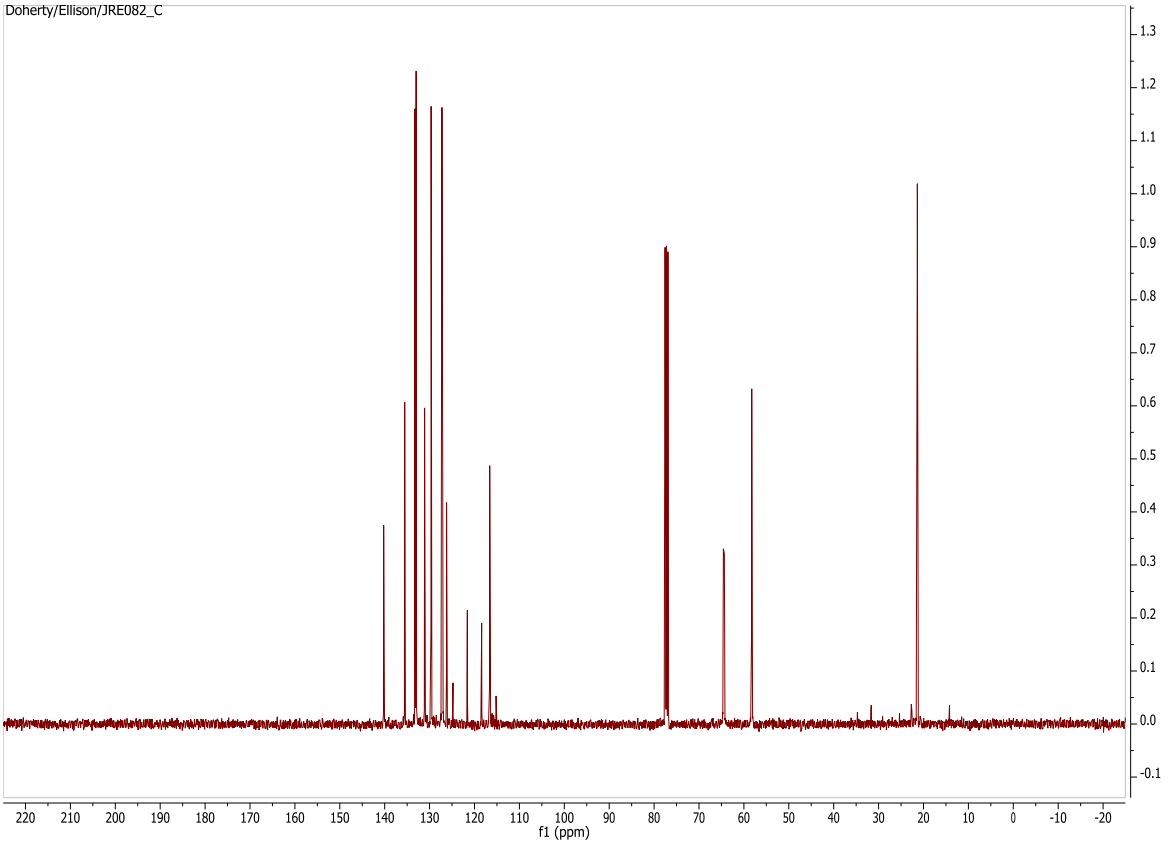

Figure S7 ^{19}F NMR spectrum of 1-venzyl-1-(4-vinylbenzyl)pyrrolidinium bistrifimide (**9.NTf$_2$**)

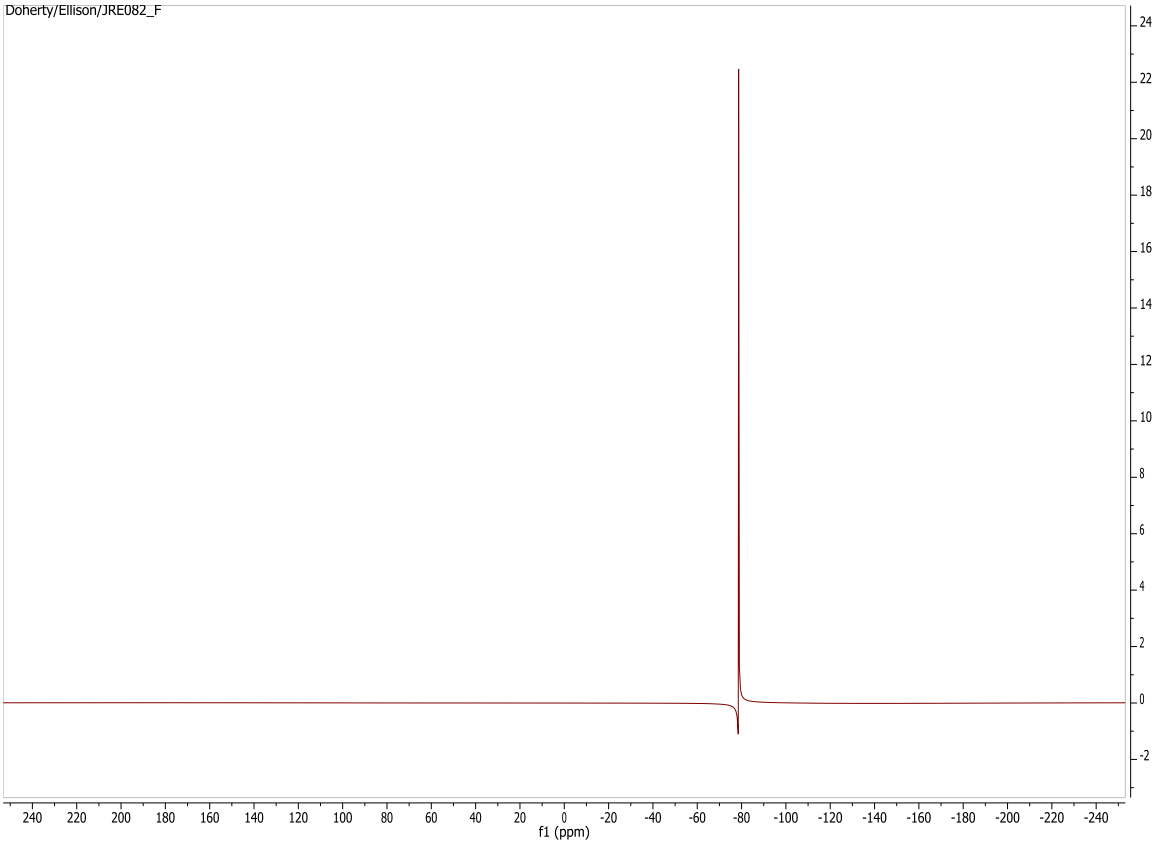

Figure S8 ^{1}H NMR spectrum of 1,1-vis(4-vinylbenzyl)pyrrolidin-1-ium bromide (**10.Br**)

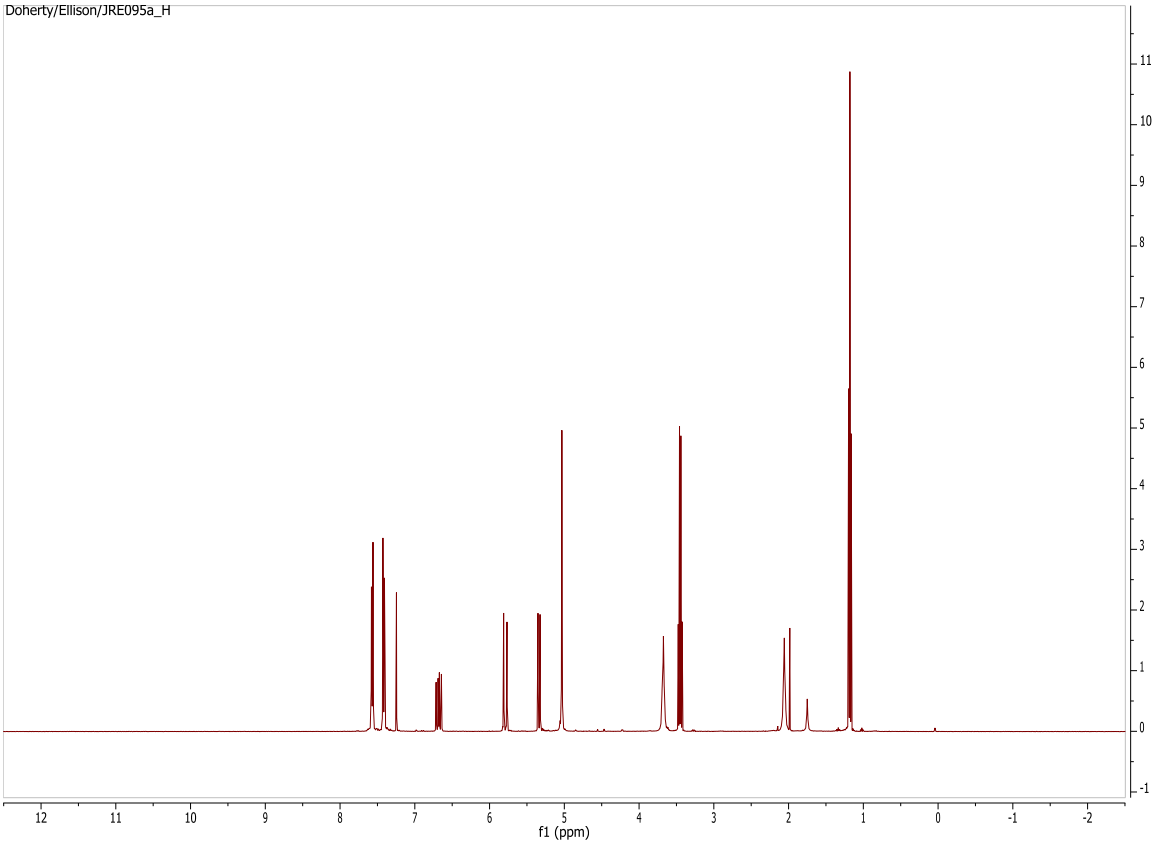

Figure S9 ^{13}C NMR spectrum of 1,1-vis(4-vinylbenzyl)pyrrolidin-1-ium bromide (**10.Br**)

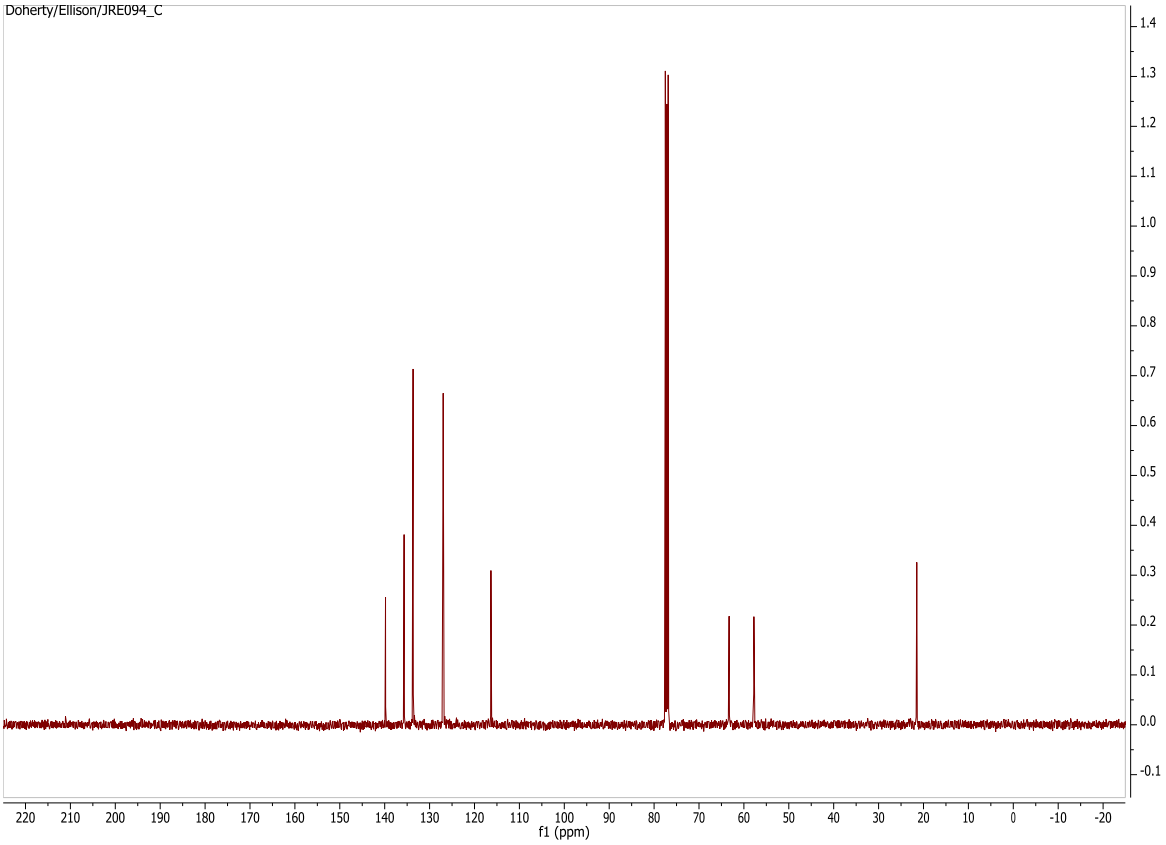

Figure S10 ^{1}H NMR spectrum of 1,1-vis(4-vinylbenzyl)pyrrolidin-1-ium bistriflimide (**10.NTf$_2$**)

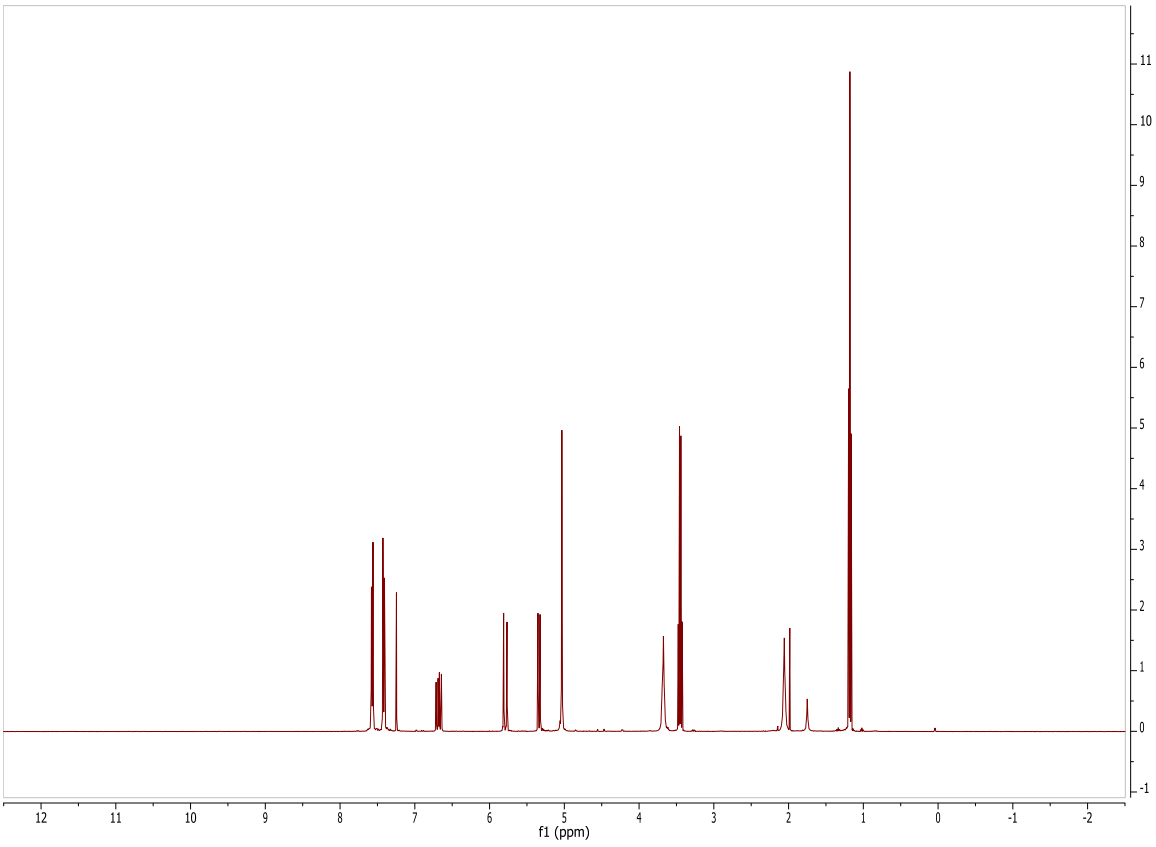

Figure S11 ^{13}C NMR spectrum of 1,1-vis(4-vinylbenzyl)pyrrolidin-1-ium bistriflimide (**10.NTf$_2$**)

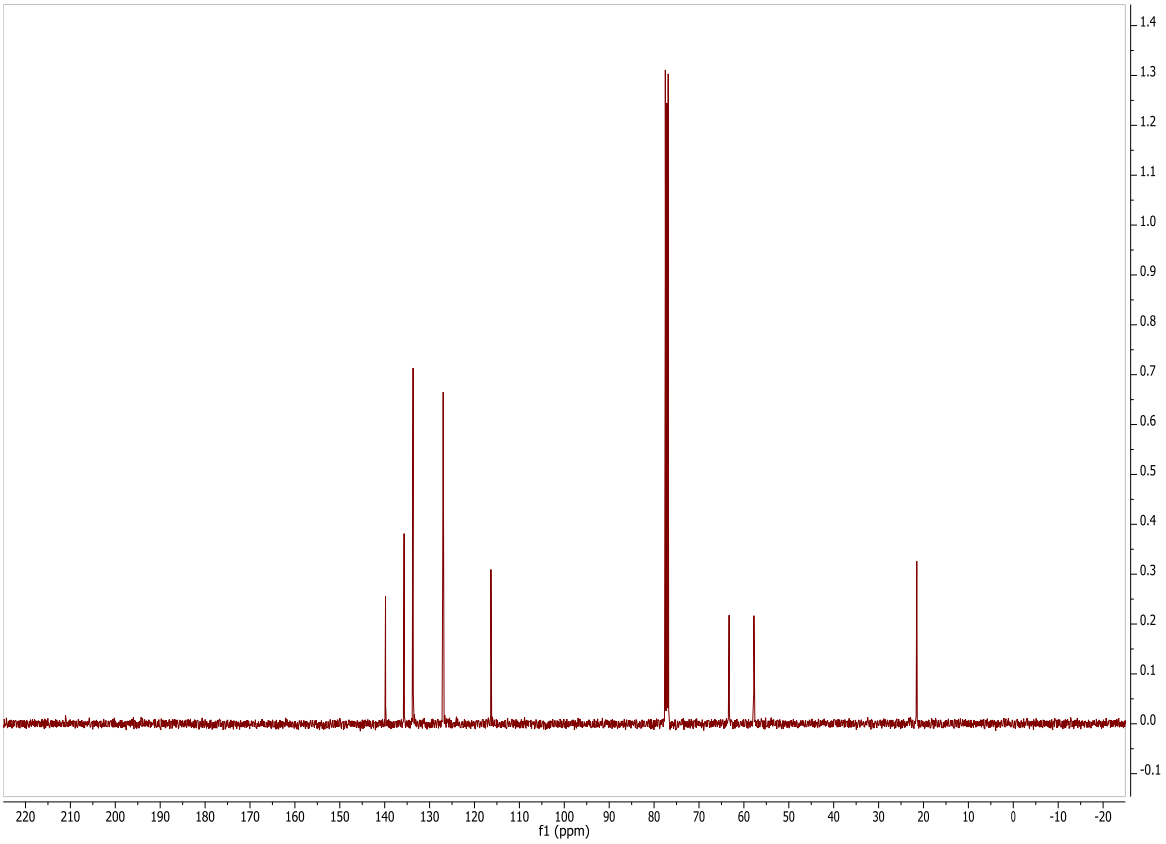

Figure S12 ^{19}C NMR spectrum of 1,1-vis(4-vinylbenzyl)pyrrolidin-1-ium bistriflimide (**10.NTf$_2$**)

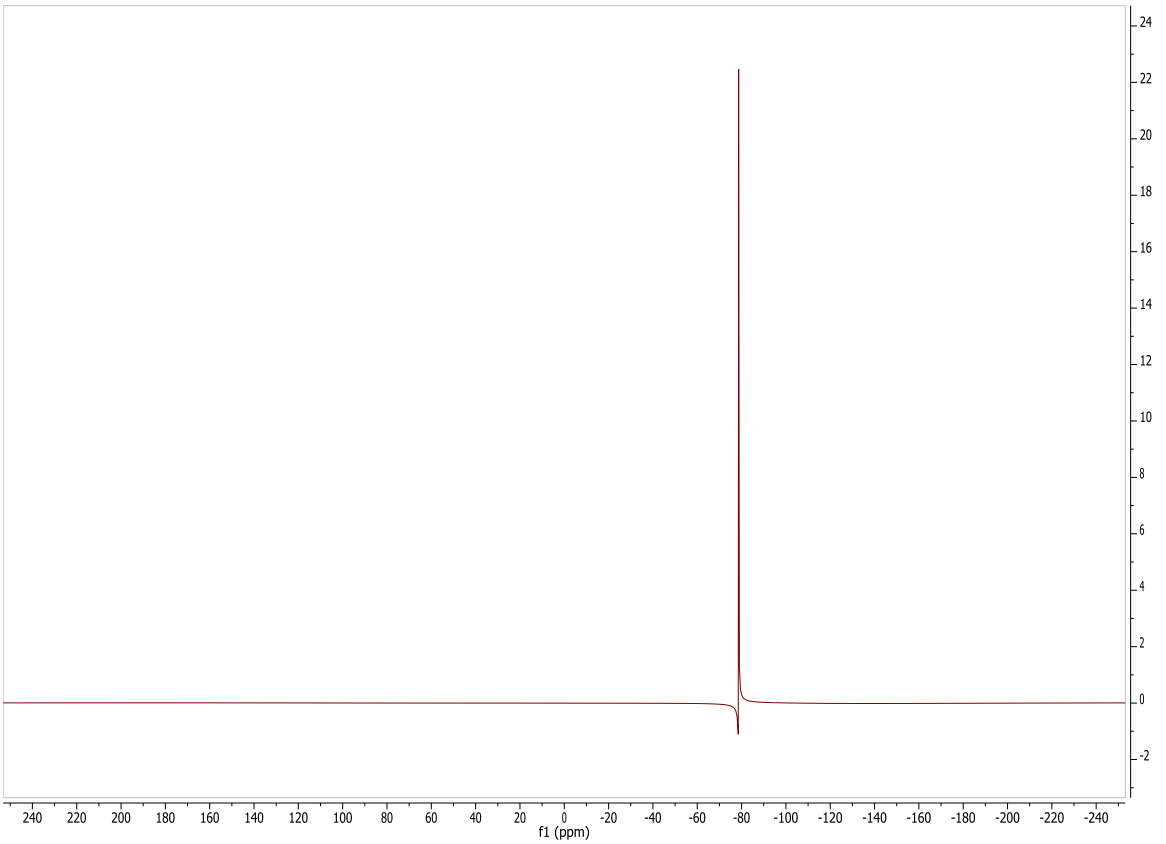

Figure S13: TGA of in house synthesised IP-**1**

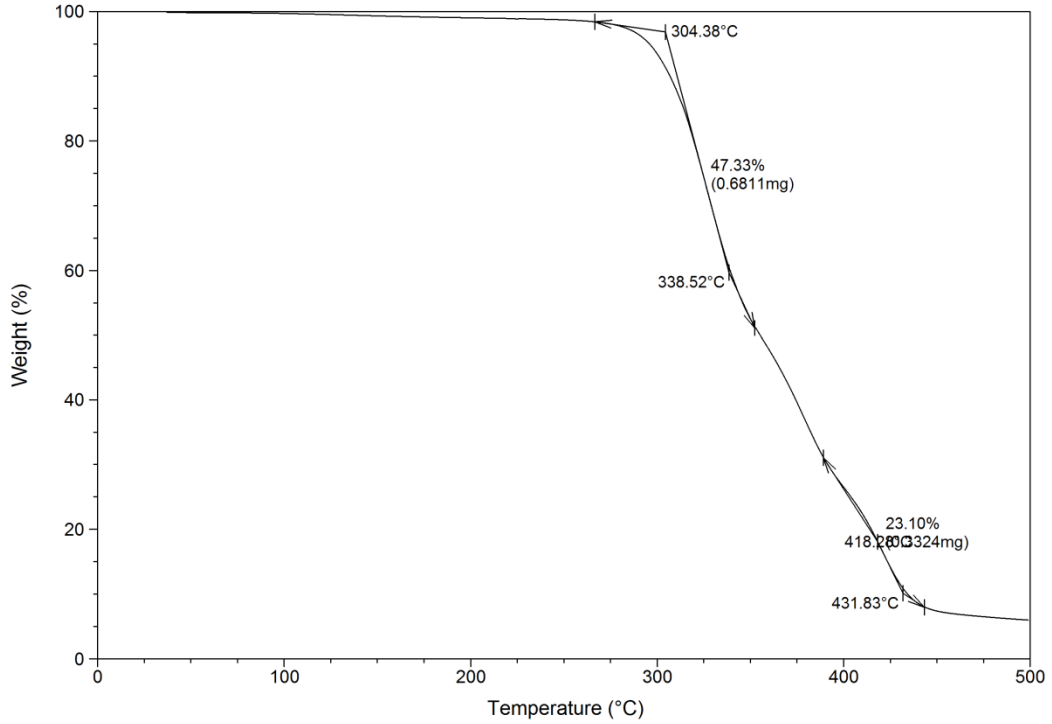

Figure S14: TGA of in house synthesised IP-**2**

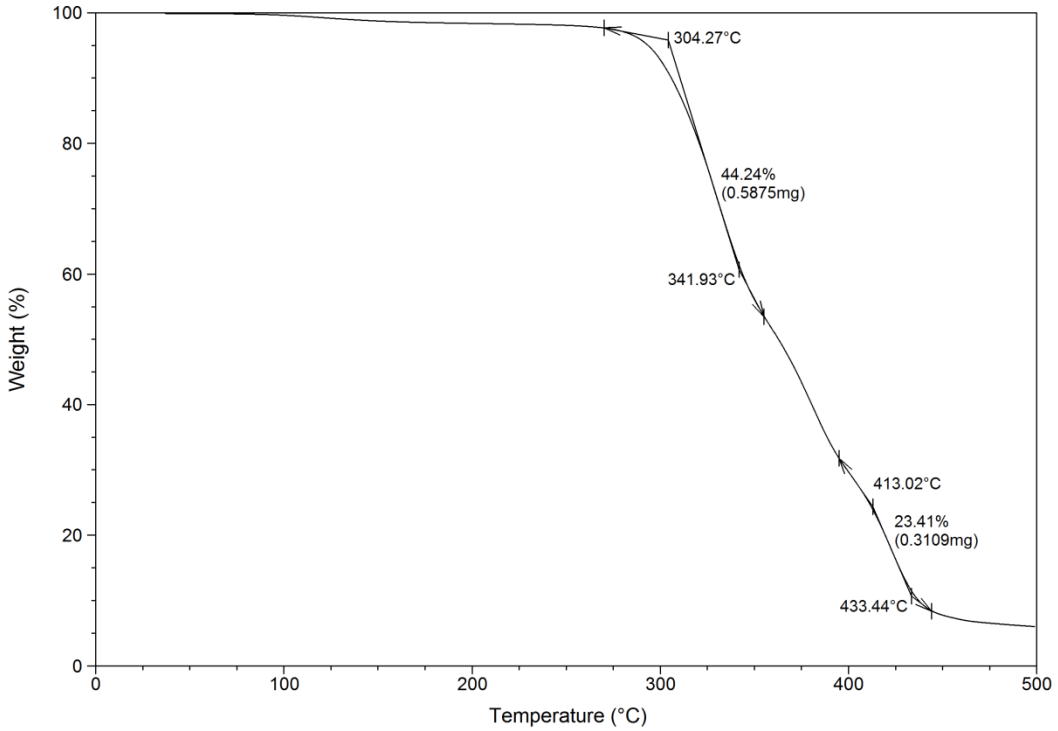

Figure S15: TGA of in house synthesised IP-**3**

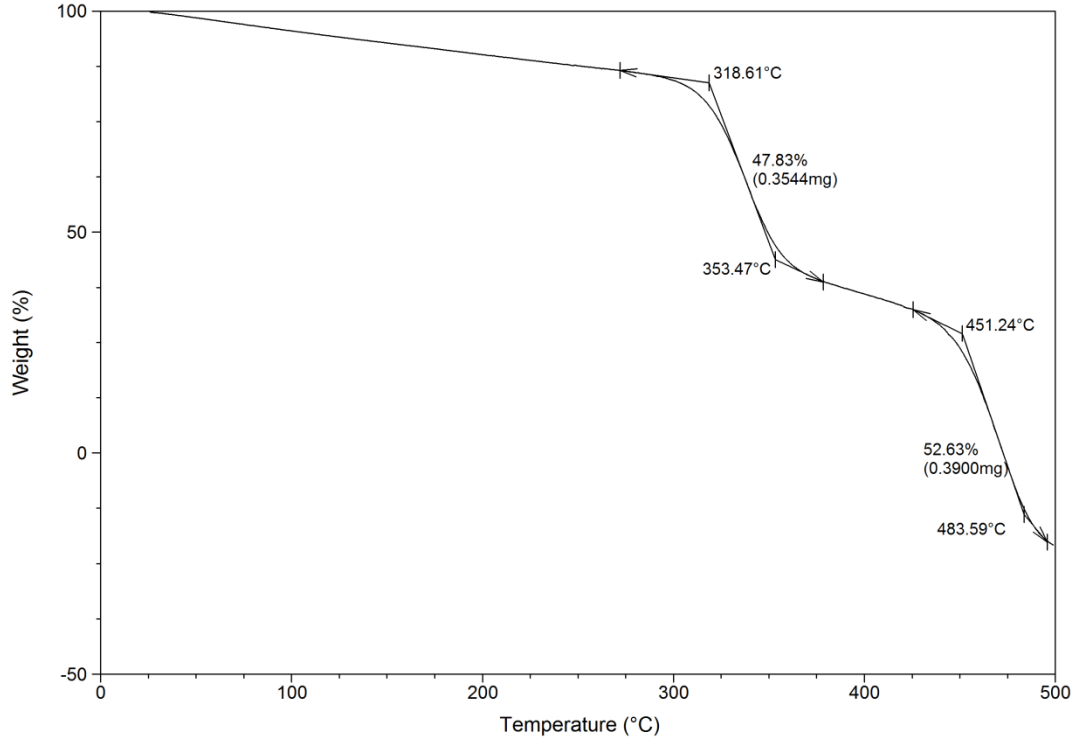

Figure S16: TGA of in house synthesised IP-**4**

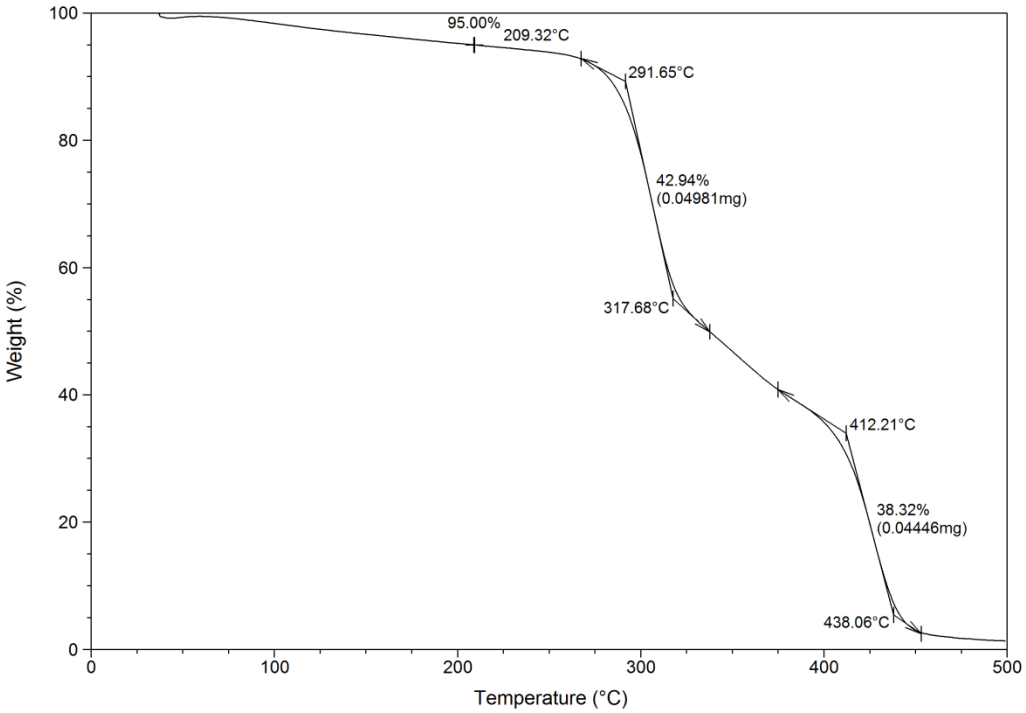

Figure S17: TGA of commercial polymer IP-**5**

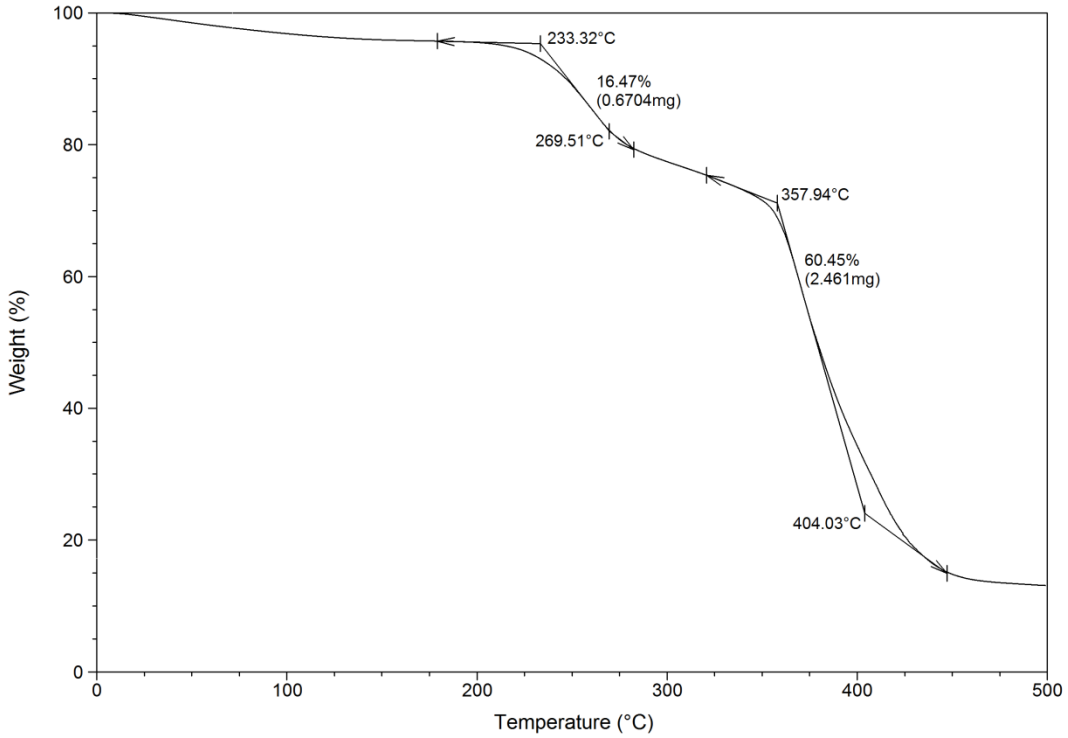

Figure S18: TGA of commercial polymer IP-**6**

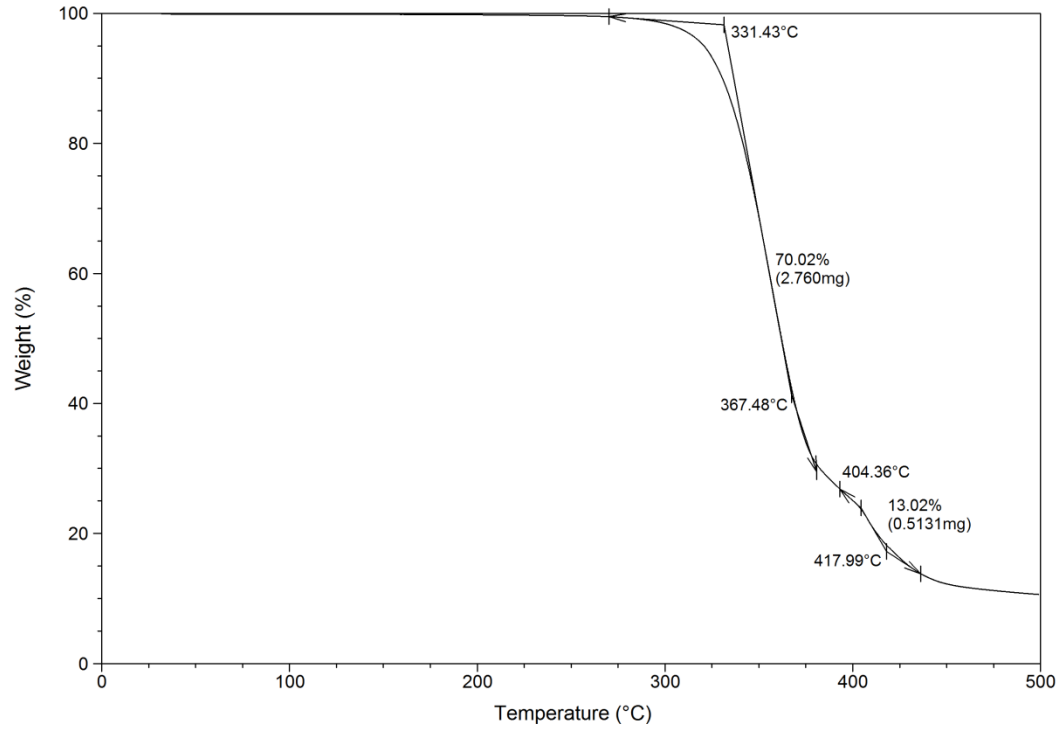

Figure S19: TGA of non-ionic polystyrene P-**7**

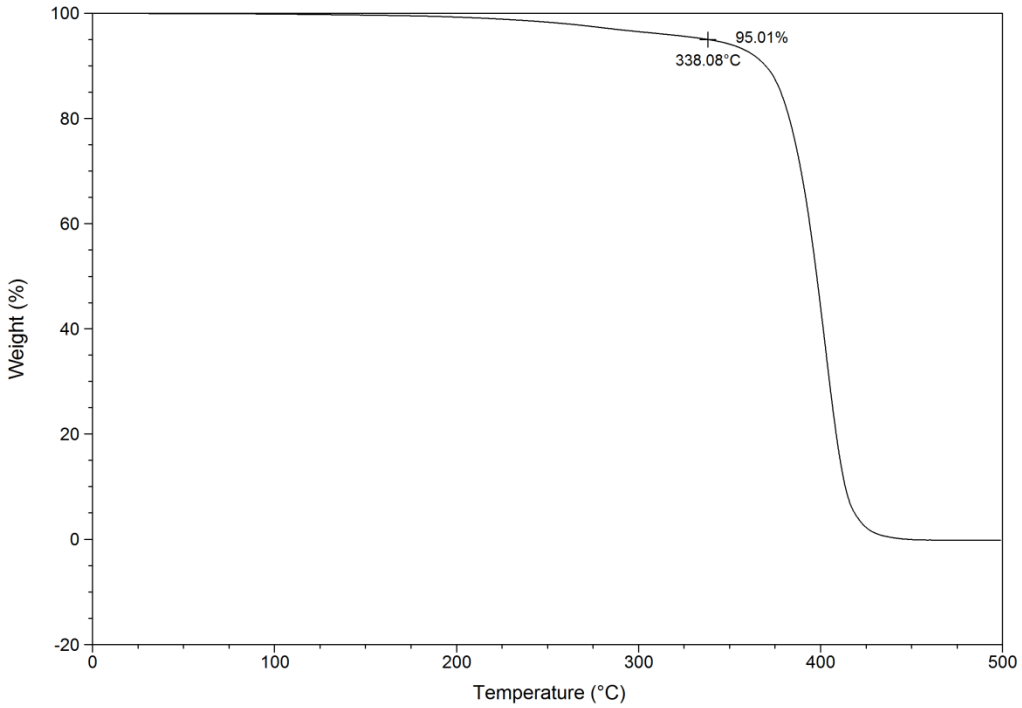

Figure S20: SEM of in house synthesised IP-**1**

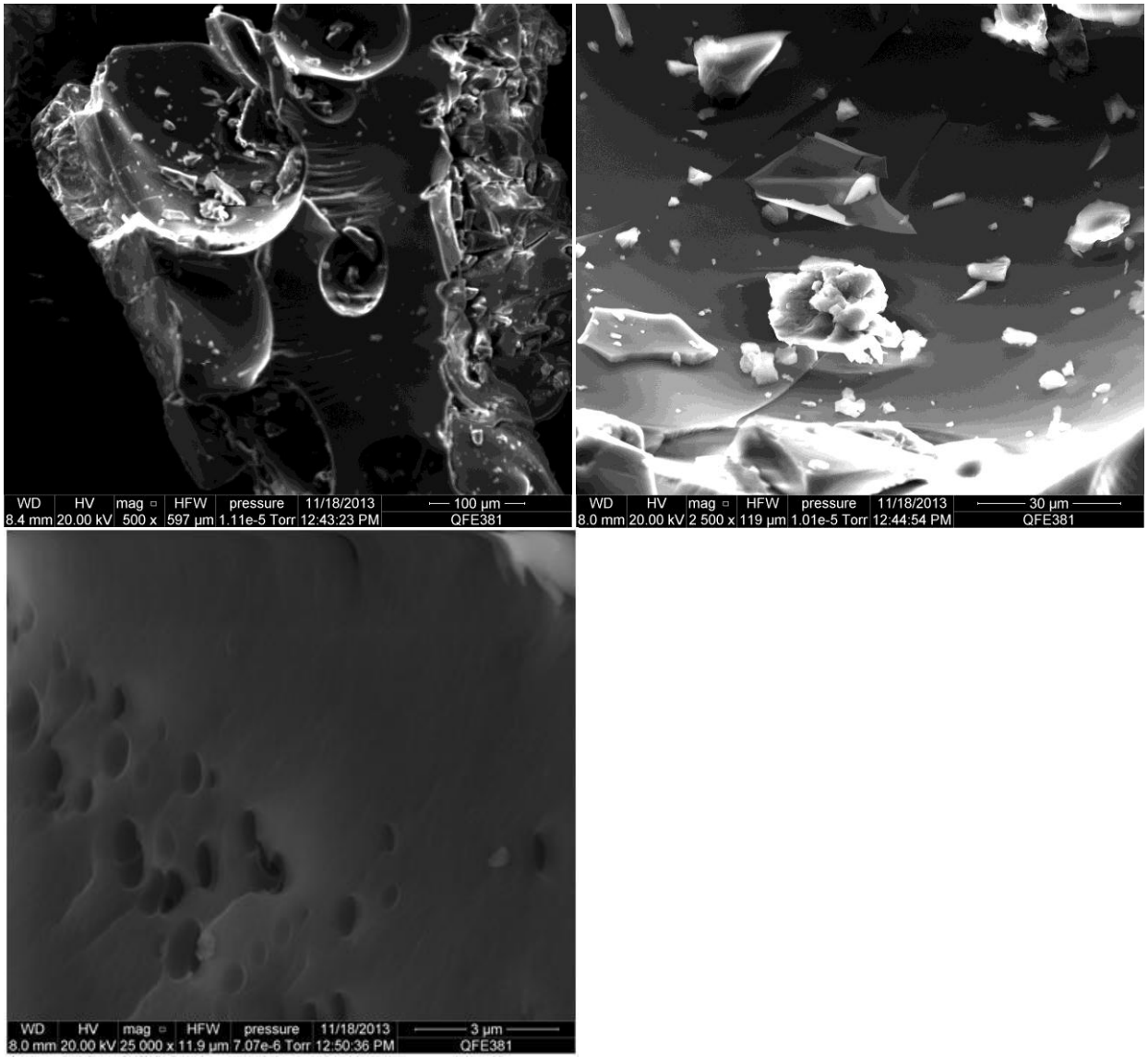

Figure S21: SEM of inhouse synthesised IP-**2**

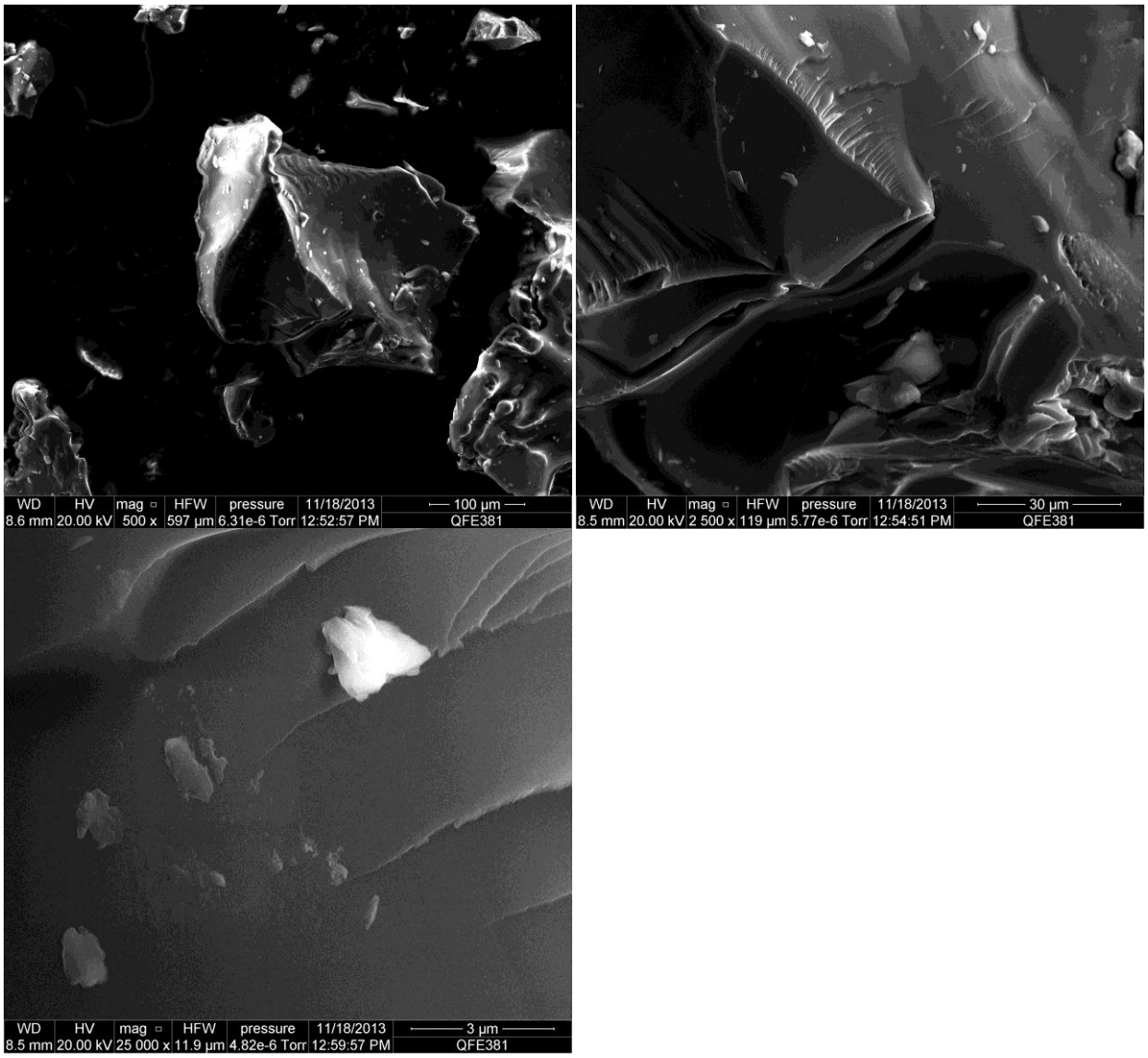

Figure S22: SEM of inhouse synthesised IP-**3**

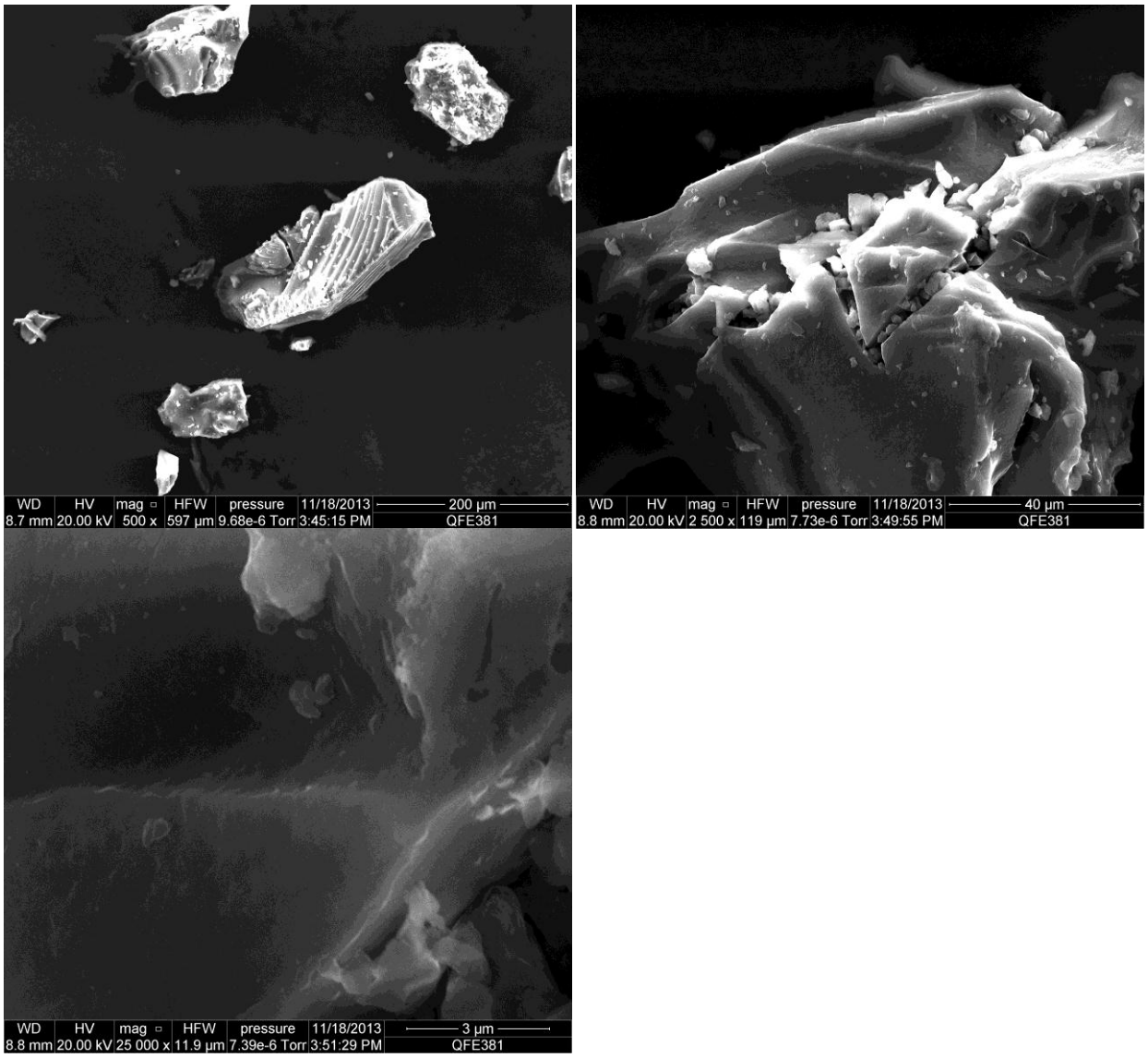

Figure S23: SEM of inhouse synthesised IP-**4**

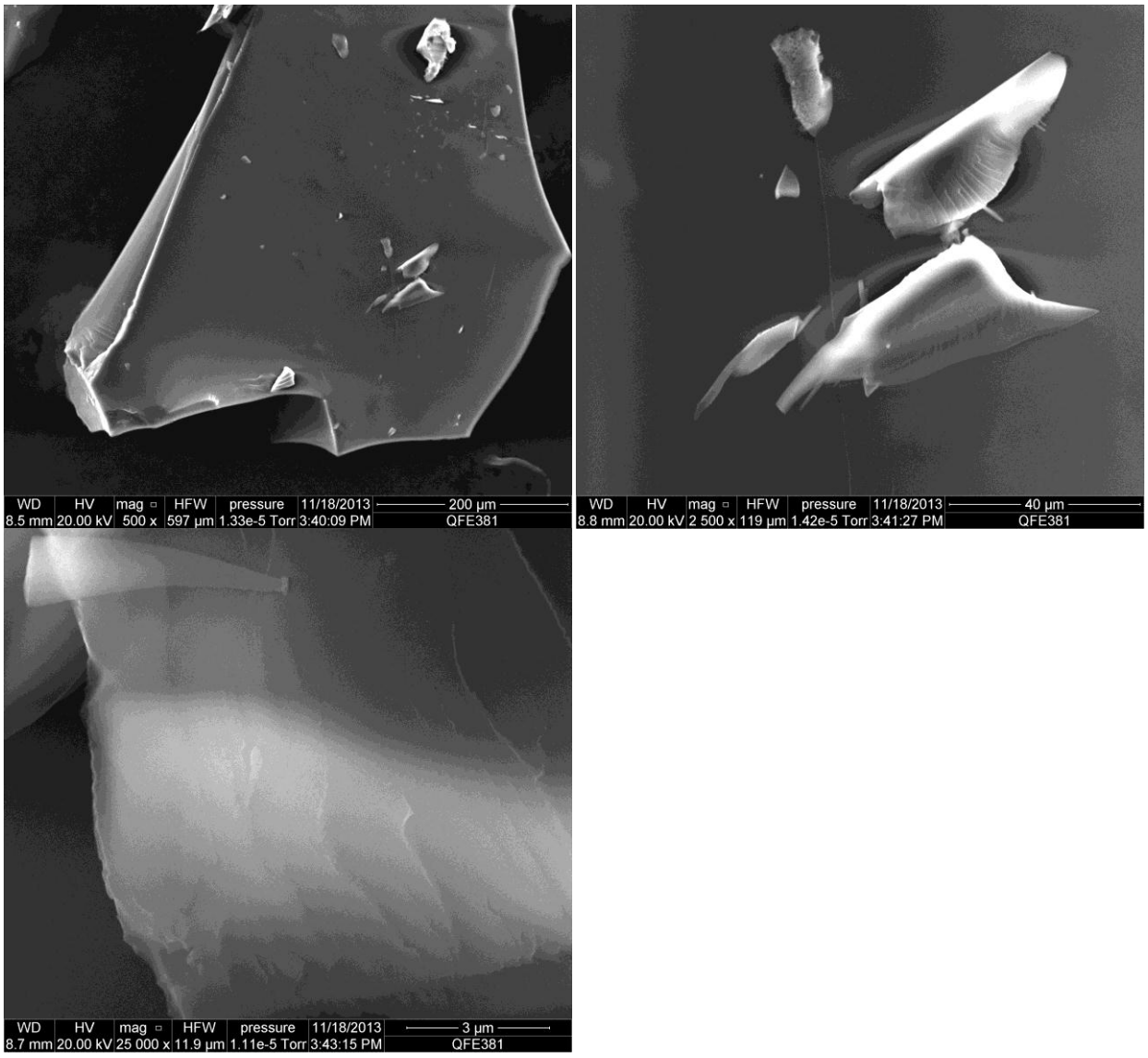

Figure S24: SEM of inhouse synthesised IP-**5**

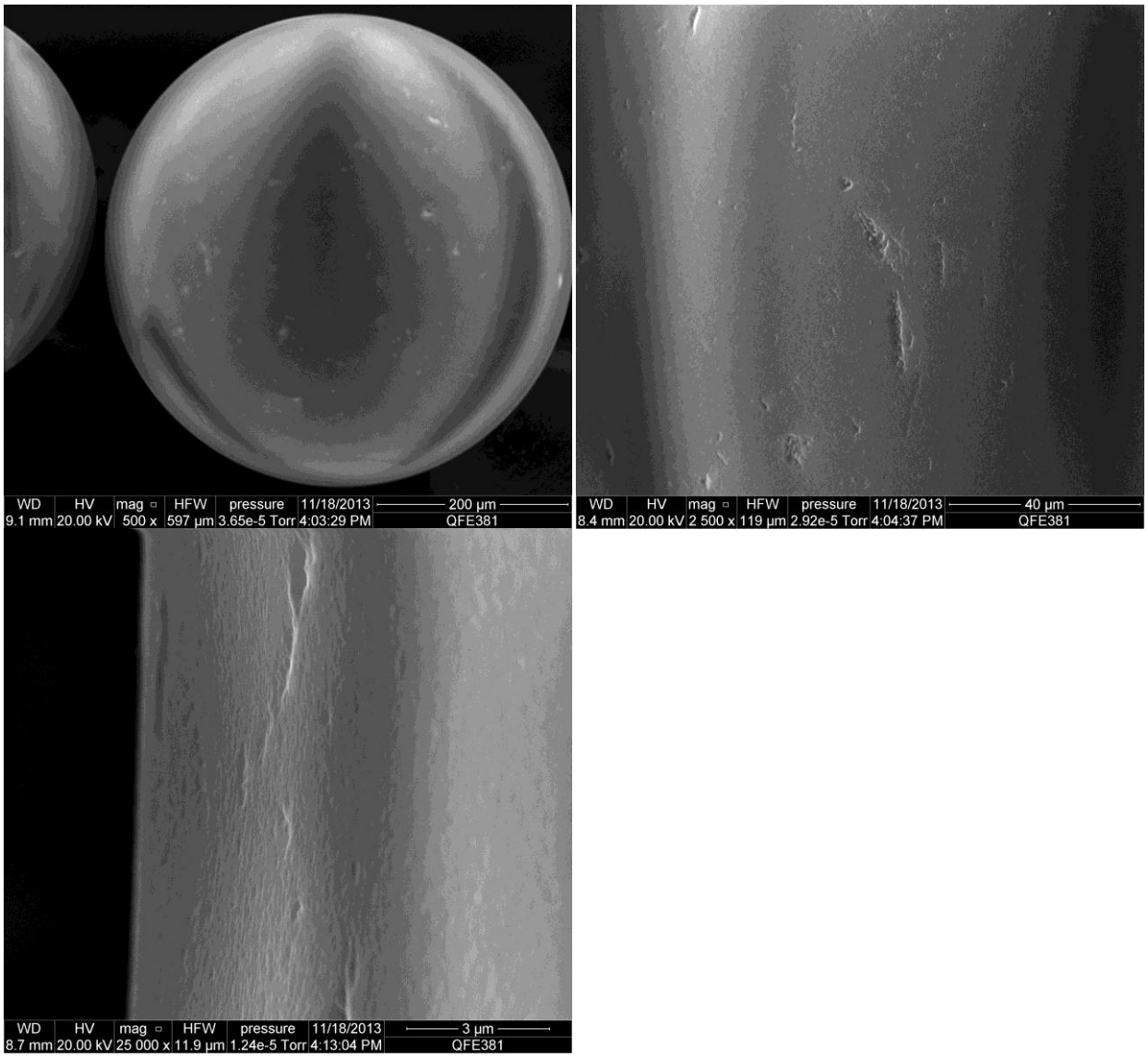

Figure S25: SEM of inhouse synthesised IP-**6**

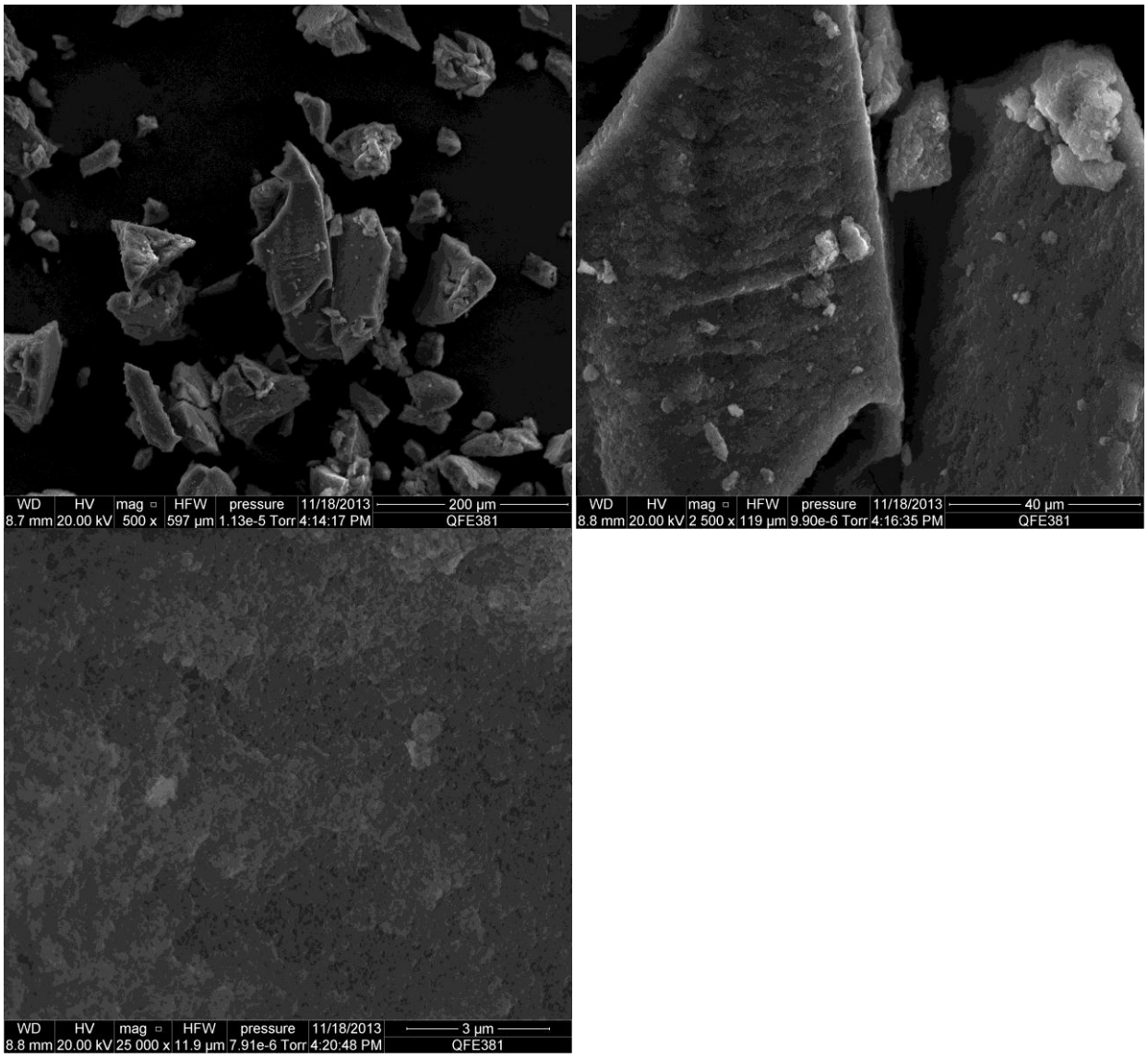

Figure S26: SEM of P-**7** Au coated

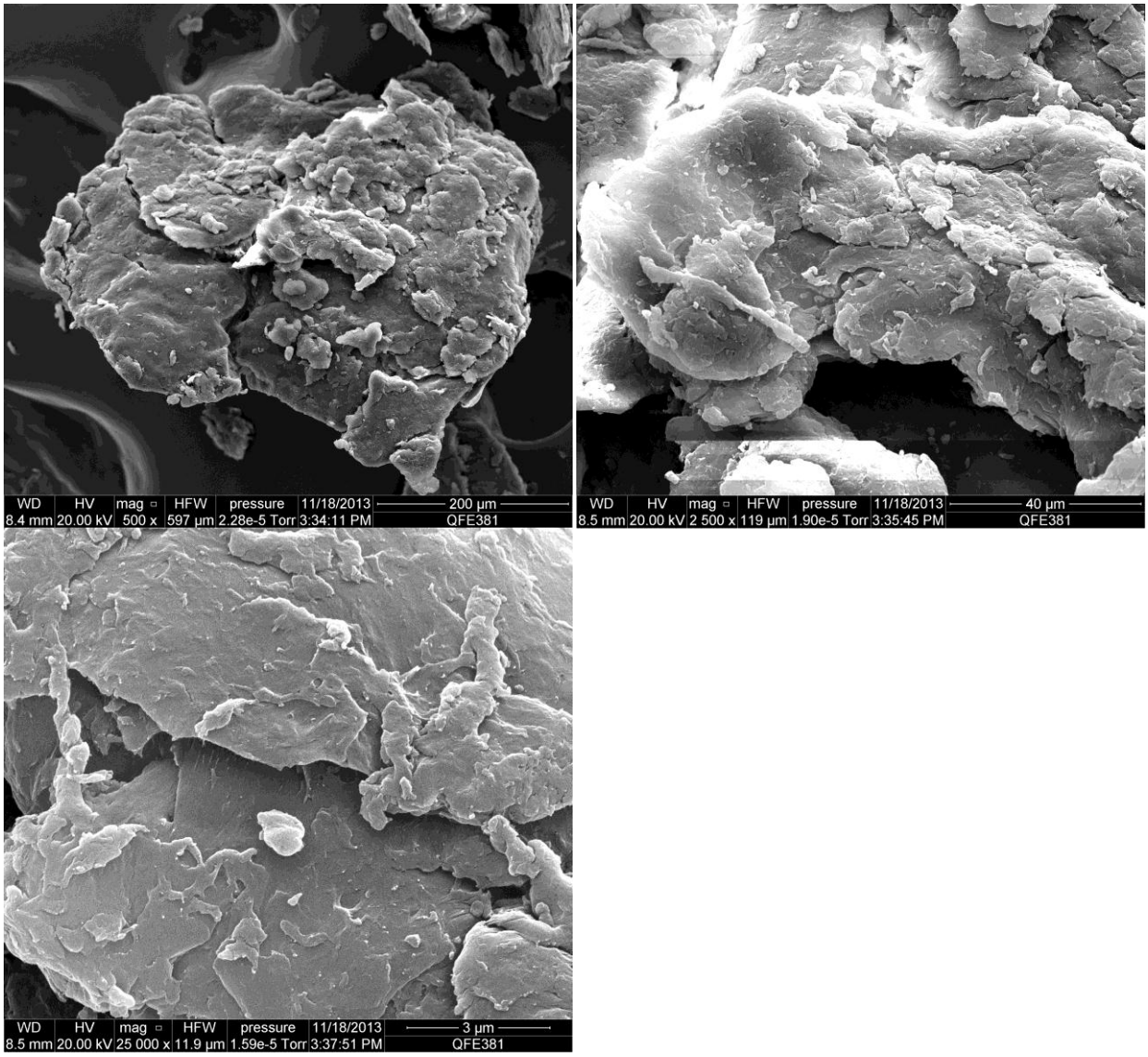

Figure S27: IR of in house synthesised IP -**1**

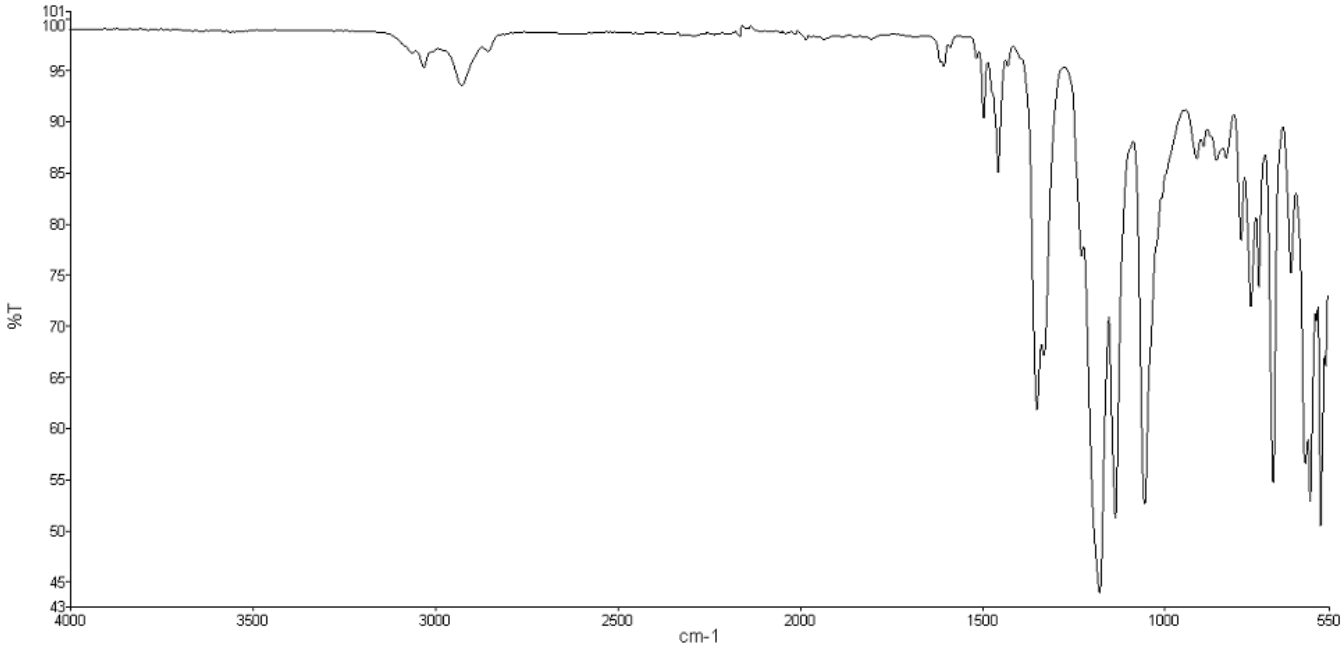

Figure S28: IR of in house synthesised IP -**2**

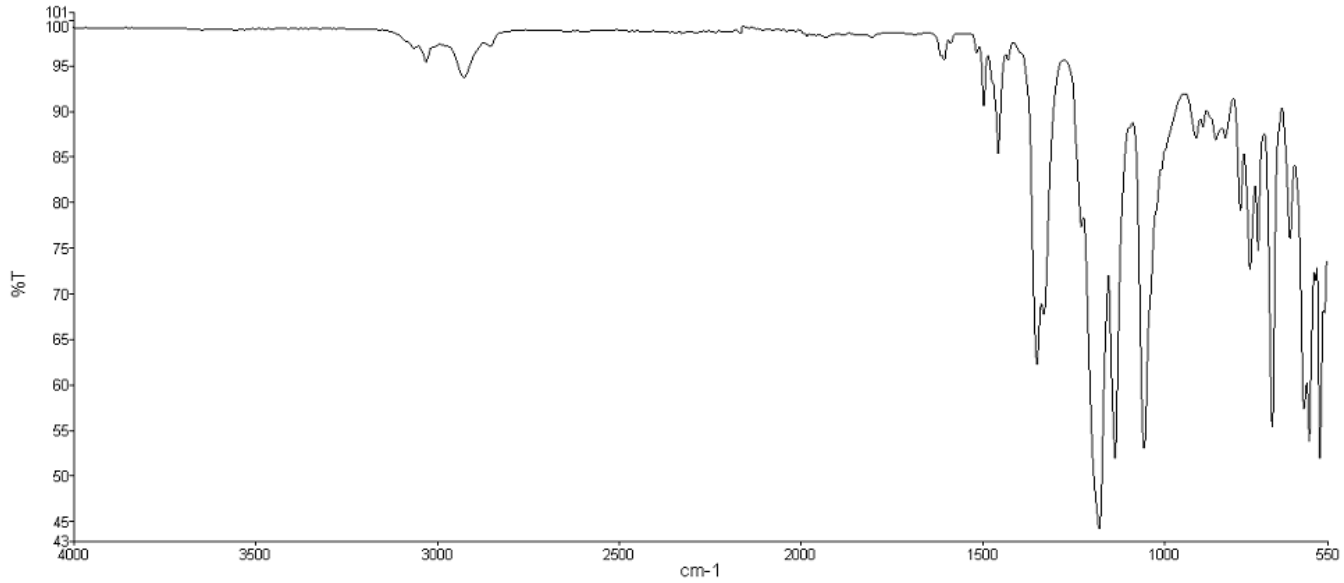

Figure S29: IR of in house synthesised IP -**3**

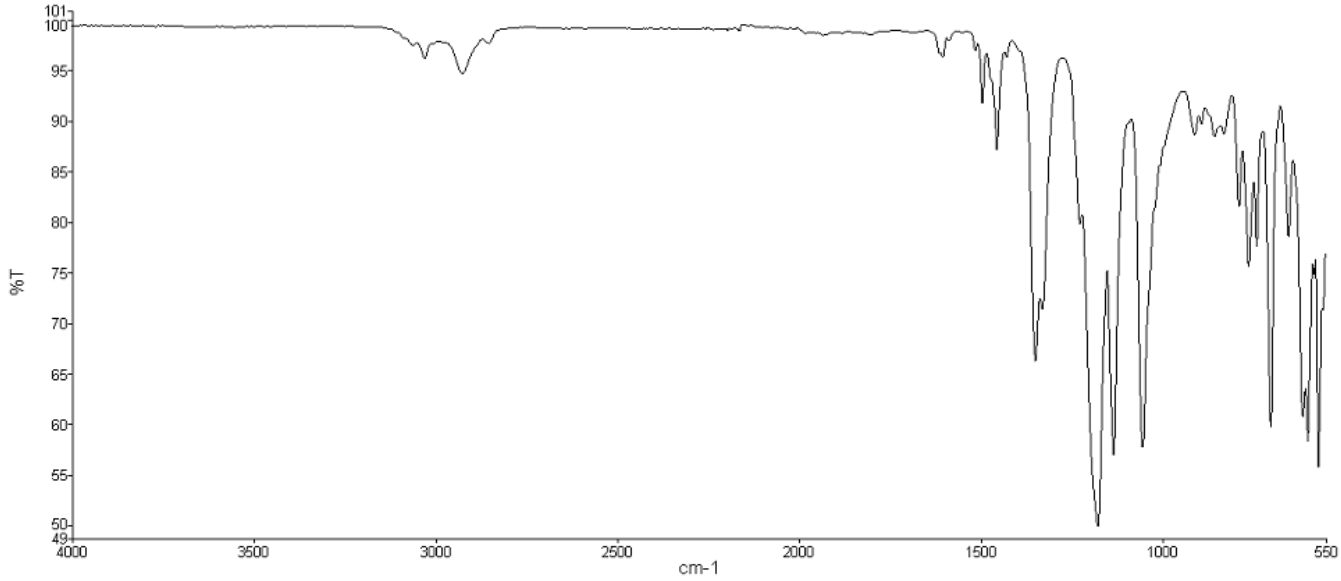

Figure S30: IR of in house synthesised IP -**4**

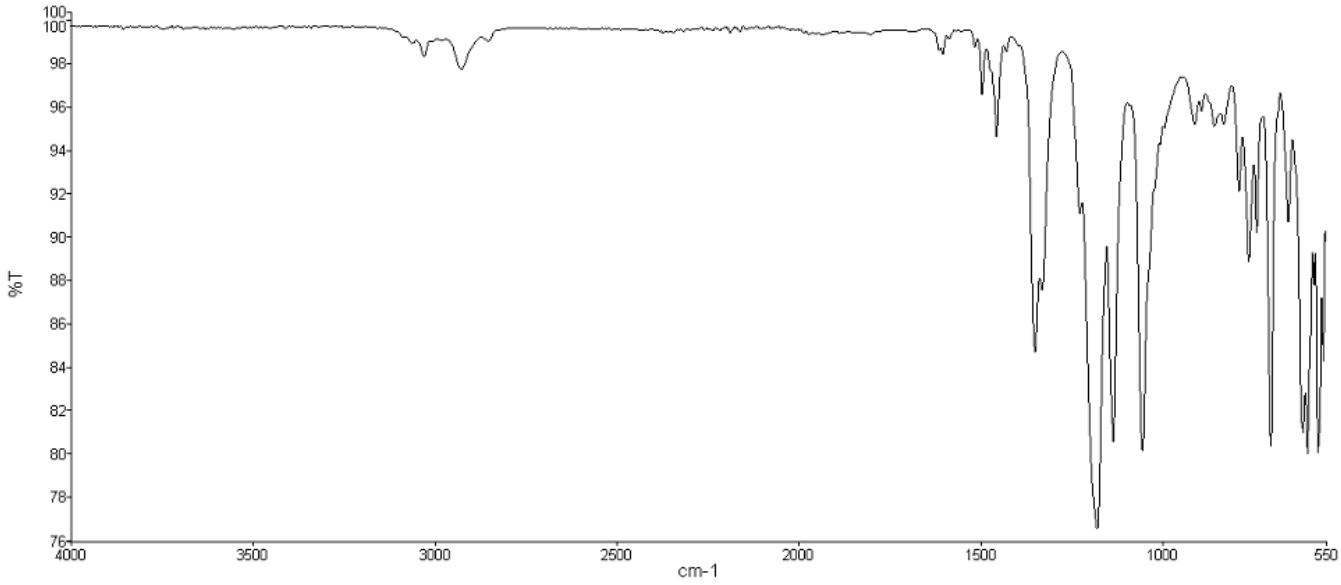

Figure S31: IR of commercial polymer IP -**5**

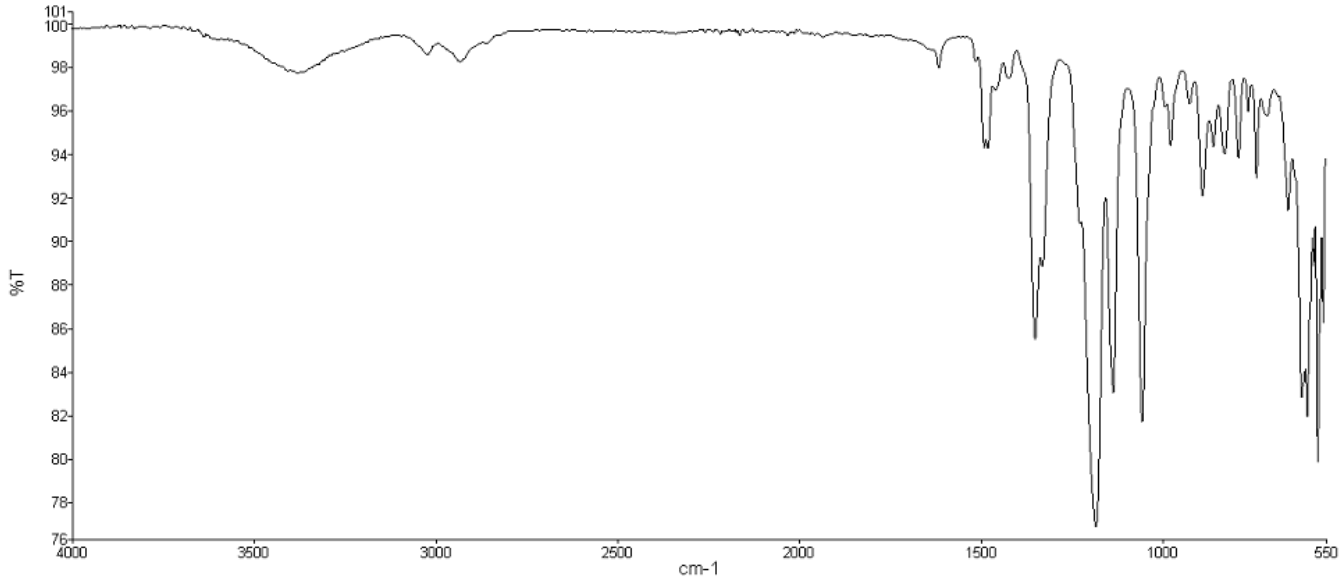

Figure S32: IR of commercial polymer IP -**6**

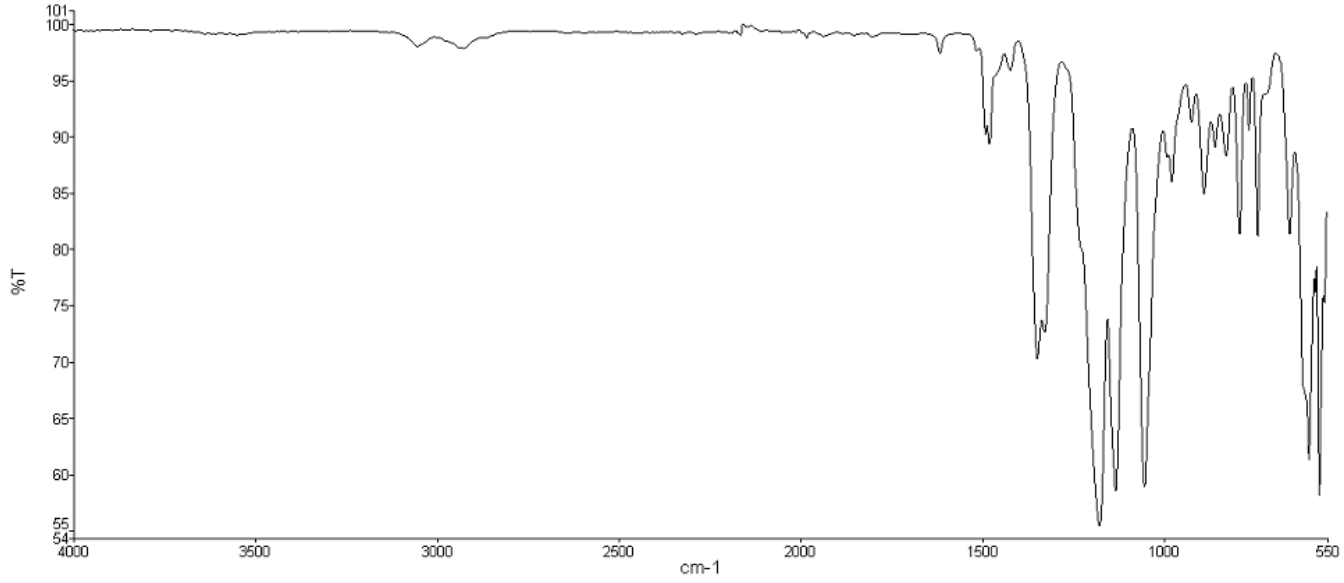

Figure S33: IR of commercial polymer P -**7**

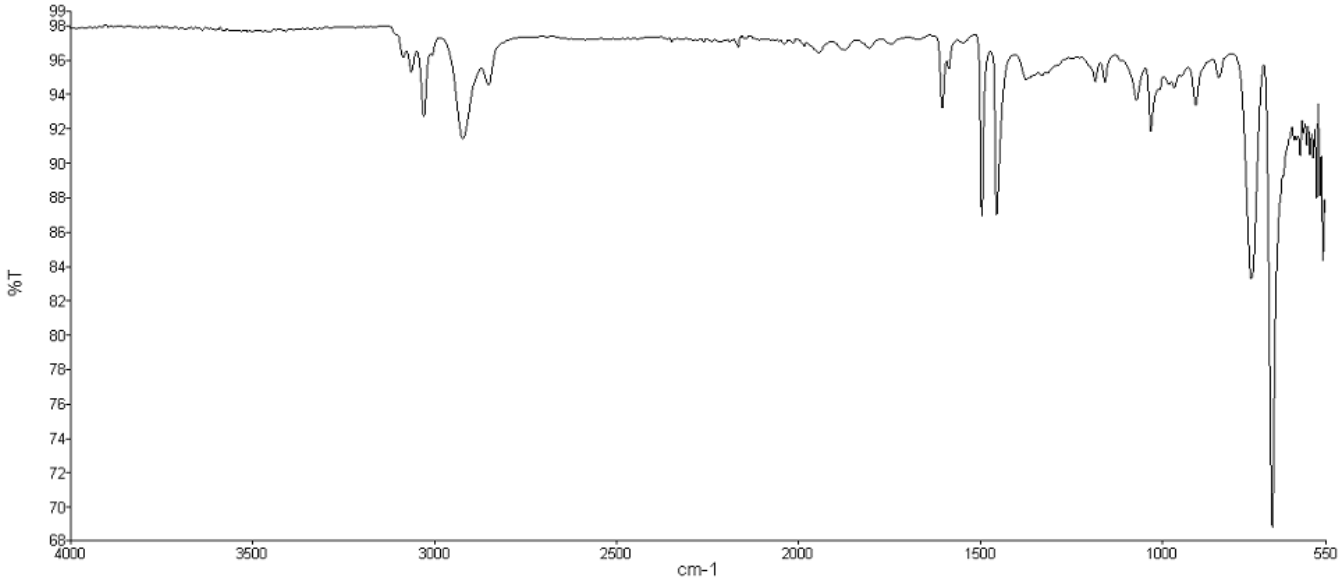

Figure S34: IR of in house synthesised IP-**1** (top) , IP-**1** + catalyst **A** (middle) and IP-**1** + catalyst **A** (bottom) after a Diels-Alder reaction

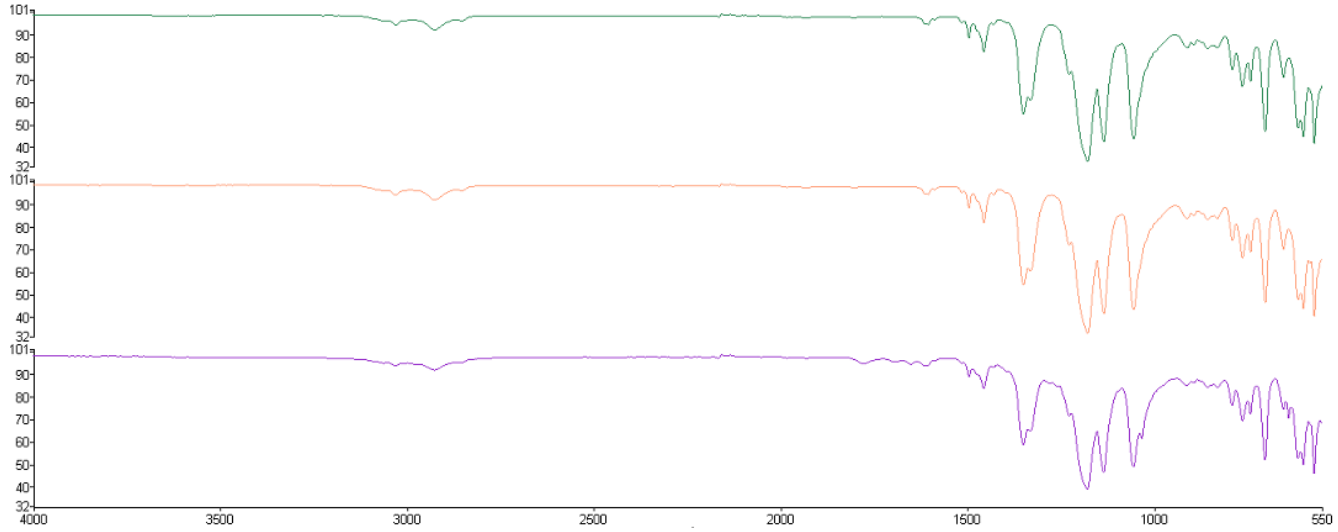

Figure S35: HPLC traces of the exo and endo-cycloadducts observed from a racemic reaction mixture and that obtained from a reaction using IP-**4** catalyst **A** complex

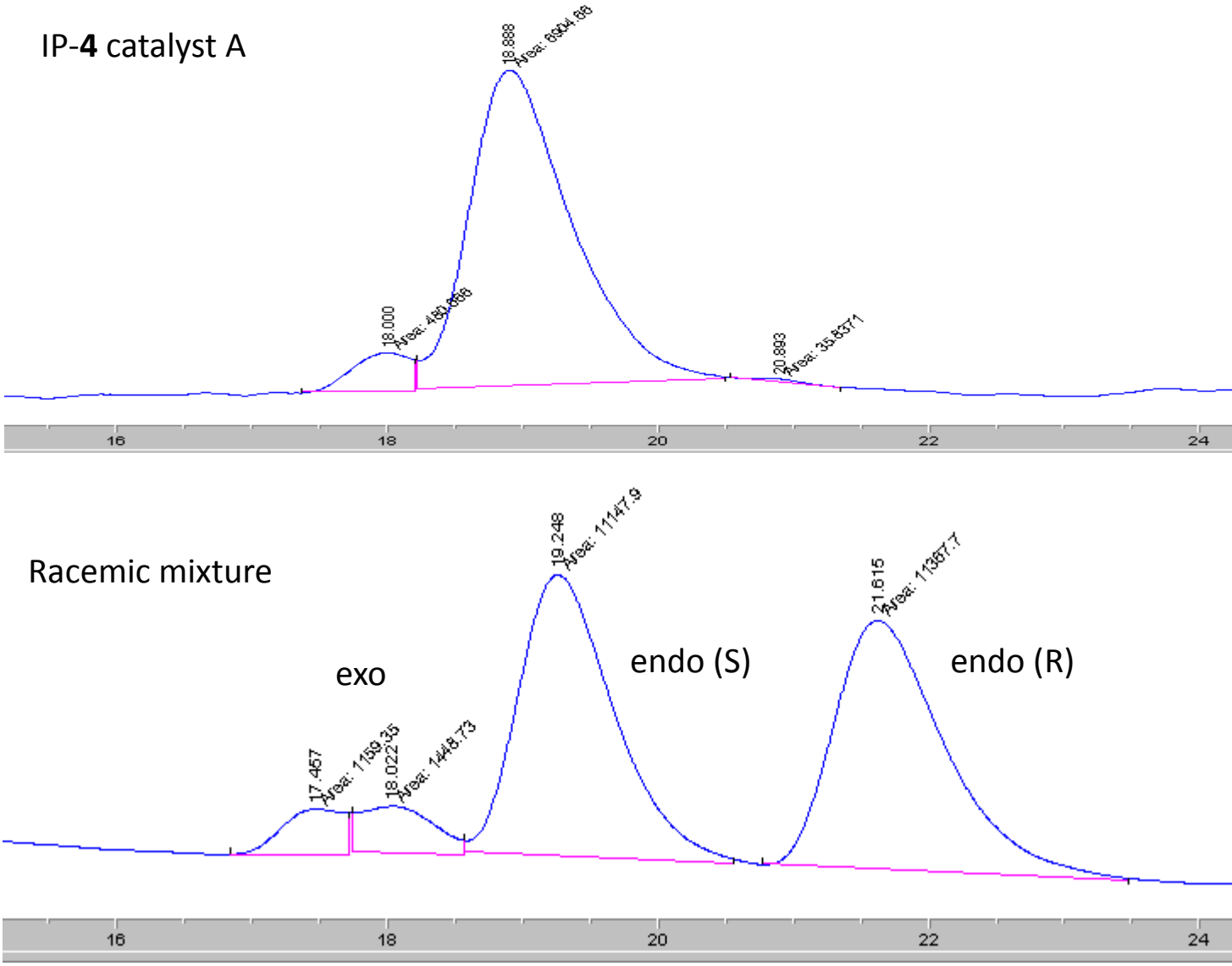

Figure S36: HPLC traces of the aldol adducts observed from a racemic reaction mixture and that obtained from a reaction using IP-**4** catalyst **A** complex