

## Synthesis, spectroscopic, thermal and dielectric properties of phosphazene based ionic liquids: OFET application and tribological behavior

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### Supporting Information

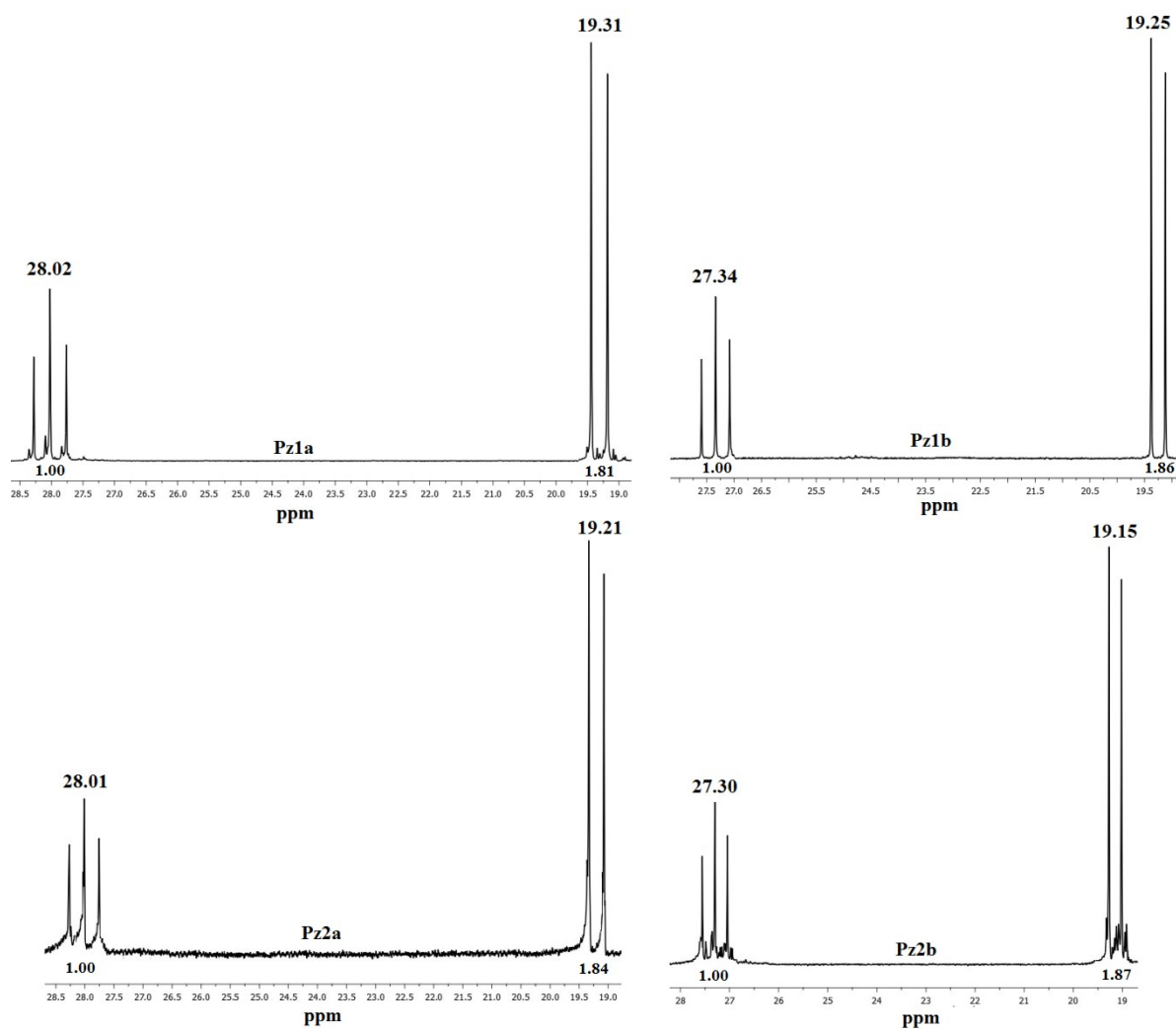
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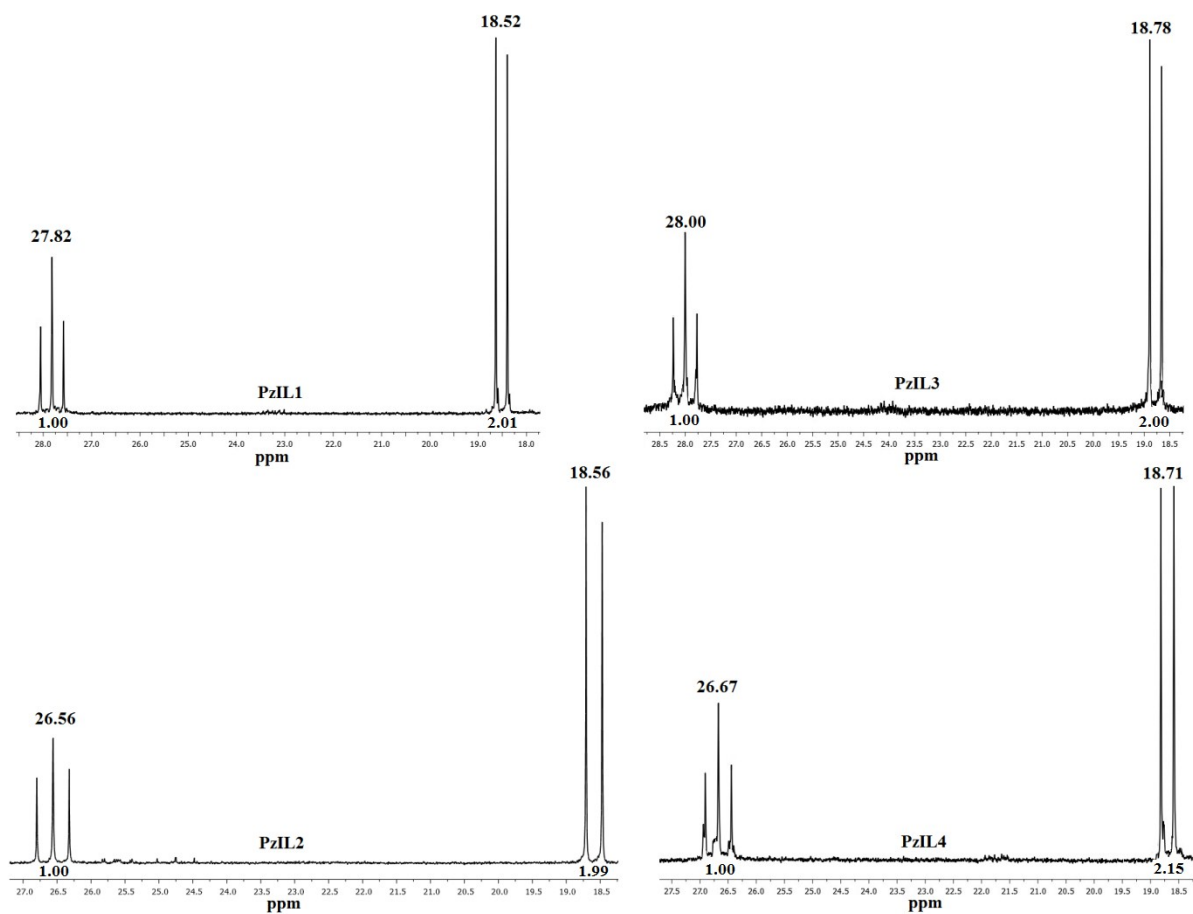
**Table S1** Thermoanalytical data of Pzs and PzILs

| Compound                                                                                                                                                                                                                                                 | Stage | Temperature range/°C | DTG <sub>max</sub> (°C) | Mass loss (Obs.)/Δm % |       | Total mass loss (Obs.)/Δm % | Removed water        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|-------------------------|-----------------------|-------|-----------------------------|----------------------|
|                                                                                                                                                                                                                                                          |       |                      |                         | Found                 | Calc. |                             |                      |
| [P <sub>1</sub> 2P <sub>11</sub> 3N].7/2H <sub>2</sub> O ( <b>Pz1a</b> )<br>C <sub>26</sub> H <sub>60</sub> FN <sub>9</sub> O <sub>7.5</sub> P <sub>3</sub><br>730.74 gmol <sup>-1</sup>                                                                 | 1     | 42-169               | 124                     | 8.67                  | 8.63  | 95.25                       | 7/2H <sub>2</sub> O  |
|                                                                                                                                                                                                                                                          | 2     | 169-297              | 229                     | 38.73                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 3     | 297-347              | 327                     | 8.34                  |       |                             |                      |
|                                                                                                                                                                                                                                                          | 4     | 347-412              | 377                     | 10.35                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 5     | 412-615              | 486                     | 15.28                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 6     | 615-1150             | 715                     | 13.88                 |       |                             |                      |
| [P <sub>1</sub> 2P <sub>22</sub> 3N].11/2H <sub>2</sub> O ( <b>Pz1b</b> )<br>C <sub>30</sub> H <sub>72</sub> FN <sub>9</sub> O <sub>9.5</sub> P <sub>3</sub><br>822.88 gmol <sup>-1</sup>                                                                | 1     | 35-151               | 105                     | 12.09                 | 12.04 | 97.79                       | 11/2H <sub>2</sub> O |
|                                                                                                                                                                                                                                                          | 2     | 151-204              | 180                     | 6.64                  |       |                             |                      |
|                                                                                                                                                                                                                                                          | 3     | 204-327              | 249                     | 38.83                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 4     | 327-371              | 343                     | 10.29                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 5     | 371-535              | 471                     | 14.91                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 6     | 535-1150             | 730                     | 15.03                 |       |                             |                      |
| [P <sub>2</sub> 2P <sub>11</sub> 3N].6H <sub>2</sub> O ( <b>Pz2a</b> )<br>C <sub>27</sub> H <sub>67</sub> FN <sub>9</sub> O <sub>10</sub> P <sub>3</sub><br>789.81 gmol <sup>-1</sup>                                                                    | 1     | 35-178               | 105                     | 13.71                 | 13.69 | 95.97                       | 6H <sub>2</sub> O    |
|                                                                                                                                                                                                                                                          | 2     | 178-247              | 222                     | 23.95                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 3     | 247-344              | 267                     | 24.33                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 4     | 344-425              | 368                     | 8.24                  |       |                             |                      |
|                                                                                                                                                                                                                                                          | 5     | 425-615              | 505                     | 13.97                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 6     | 615-1150             | 706                     | 11.77                 |       |                             |                      |
| [P <sub>2</sub> 2P <sub>22</sub> 3N].20H <sub>2</sub> O ( <b>Pz2b</b> )<br>C <sub>31</sub> H <sub>103</sub> FN <sub>9</sub> O <sub>24</sub> P <sub>3</sub><br>1098.12 gmol <sup>-1</sup>                                                                 | 1     | 35-121               | 81                      | 32.78                 | 32.80 | 86.11                       | 20H <sub>2</sub> O   |
|                                                                                                                                                                                                                                                          | 2     | 121-212              | 181                     | 10.36                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 3     | 212-304              | 270                     | 26.86                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 4     | 304-425              | 374                     | 7.44                  |       |                             |                      |
|                                                                                                                                                                                                                                                          | 5     | 425-529              | 457                     | 5.88                  |       |                             |                      |
|                                                                                                                                                                                                                                                          | 6     | 529-1150             | 826                     | 2.79                  |       |                             |                      |
| [P <sub>1</sub> 2P <sub>11</sub> 3N][I] <sub>4</sub> ( <b>PzIL1</b> )<br>C <sub>30</sub> H <sub>65</sub> FI <sub>4</sub> N <sub>9</sub> O <sub>4</sub> P <sub>3</sub><br>1235.43 gmol <sup>-1</sup>                                                      | 1     | 180-364              | 267                     | 86.26                 |       | 97.08                       |                      |
|                                                                                                                                                                                                                                                          | 2     | 364-1150             | 751                     | 10.82                 |       |                             |                      |
| [P <sub>2</sub> 2P <sub>11</sub> 3N][I] <sub>4</sub> .7H <sub>2</sub> O ( <b>PzIL2</b> )<br>C <sub>31</sub> H <sub>81</sub> FI <sub>4</sub> N <sub>9</sub> O <sub>11</sub> P <sub>3</sub><br>1375.58 gmol <sup>-1</sup>                                  | 1     | 54-236               | 128                     | 9.60                  | 9.17  | 92.57                       | 7H <sub>2</sub> O    |
|                                                                                                                                                                                                                                                          | 2     | 236-398              | 279                     | 80.10                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 3     | 398-1150             | 655                     | 2.87                  |       |                             |                      |
| [P <sub>1</sub> 2P <sub>22</sub> 3N][I] <sub>4</sub> .H <sub>2</sub> O ( <b>PzIL3</b> )<br>C <sub>34</sub> H <sub>75</sub> FI <sub>4</sub> N <sub>9</sub> O <sub>5</sub> P <sub>3</sub><br>1309.57 gmol <sup>-1</sup>                                    | 1     | 137-196              | 160                     | 1.33                  | 1.38  | 96.28                       | H <sub>2</sub> O     |
|                                                                                                                                                                                                                                                          | 2     | 196-343              | 261                     | 89.96                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 3     | 343-1150             | 677                     | 4.99                  |       |                             |                      |
| [P <sub>2</sub> 2P <sub>22</sub> 3N][I] <sub>4</sub> .5H <sub>2</sub> O ( <b>PzIL4</b> )<br>C <sub>35</sub> H <sub>85</sub> FI <sub>4</sub> N <sub>9</sub> O <sub>9</sub> P <sub>3</sub><br>1395.66 gmol <sup>-1</sup>                                   | 1     | 35-236               | 161                     | 6.07                  | 6.45  | 88.90                       | 5H <sub>2</sub> O    |
|                                                                                                                                                                                                                                                          | 2     | 236-362              | 291                     | 76.59                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 3     | 1150                 | 823                     | 6.24                  |       |                             |                      |
| [P <sub>1</sub> 2P <sub>11</sub> 3N][NTf <sub>2</sub> ] <sub>4</sub> .2H <sub>2</sub> O ( <b>PzIL1a</b> )<br>C <sub>38</sub> H <sub>69</sub> F <sub>25</sub> N <sub>13</sub> O <sub>22</sub> P <sub>3</sub> S <sub>8</sub><br>1884.40 gmol <sup>-1</sup> | 1     | 35-194               | 112                     | 1.95                  | 1.91  | 96.70                       | 2H <sub>2</sub> O    |
|                                                                                                                                                                                                                                                          | 2     | 194-433              | 375                     | 85.92                 |       |                             |                      |
|                                                                                                                                                                                                                                                          | 3     | 433-1150             | 887                     | 8.83                  |       |                             |                      |

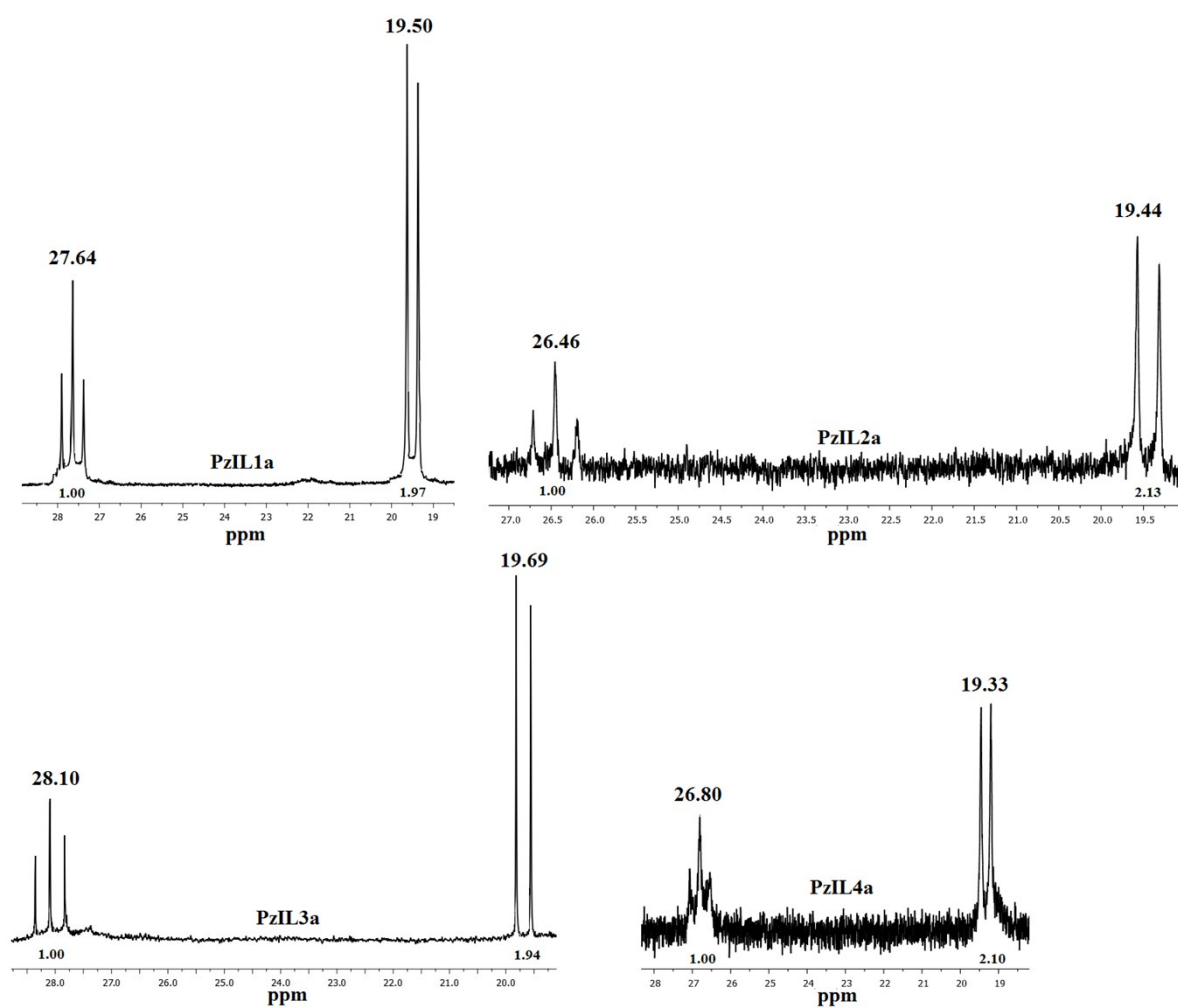
|                                                         |   |          |     |       |       |           |
|---------------------------------------------------------|---|----------|-----|-------|-------|-----------|
| $[P_2P_{11}N][NTf_2]_4 \cdot 3H_2O$ ( <b>PzIL2a</b> )   | 1 | 35-292   | 188 | 2.89  | 2.82  | $3H_2O$   |
| $C_{39}H_{73}F_{25}N_{13}O_{23}P_3S_8$                  | 2 | 292-454  | 371 | 87.78 |       |           |
| $1916.44 \text{ g mol}^{-1}$                            | 3 | 454-1150 | 875 | 6.20  | 96.87 |           |
| $[P_1P_{22}N][NTf_2]_4 \cdot 3/2H_2O$ ( <b>PzIL3a</b> ) | 1 | 35-242   | 141 | 1.36  | 1.39  | $3/2H_2O$ |
| $C_{42}H_{76}F_{25}N_{13}O_{21.5}P_3S_8$                | 2 | 242-445  | 393 | 90.08 |       |           |
| $1931.50 \text{ g mol}^{-1}$                            | 3 | 445-1150 | 822 | 6.69  | 98.13 |           |
| $[P_2P_{22}N][NTf_2]_4 \cdot 7/2H_2O$ ( <b>PzIL4a</b> ) | 1 | 35-183   | 155 | 3.25  | 3.18  | $7/2H_2O$ |
| $C_{43}H_{82}F_{25}N_{13}O_{23.5}P_3S_8$                | 2 | 183-443  | 364 | 85.39 |       |           |
| $1981.56 \text{ g mol}^{-1}$                            | 3 | 443-1150 | 826 | 4.06  | 92.70 |           |



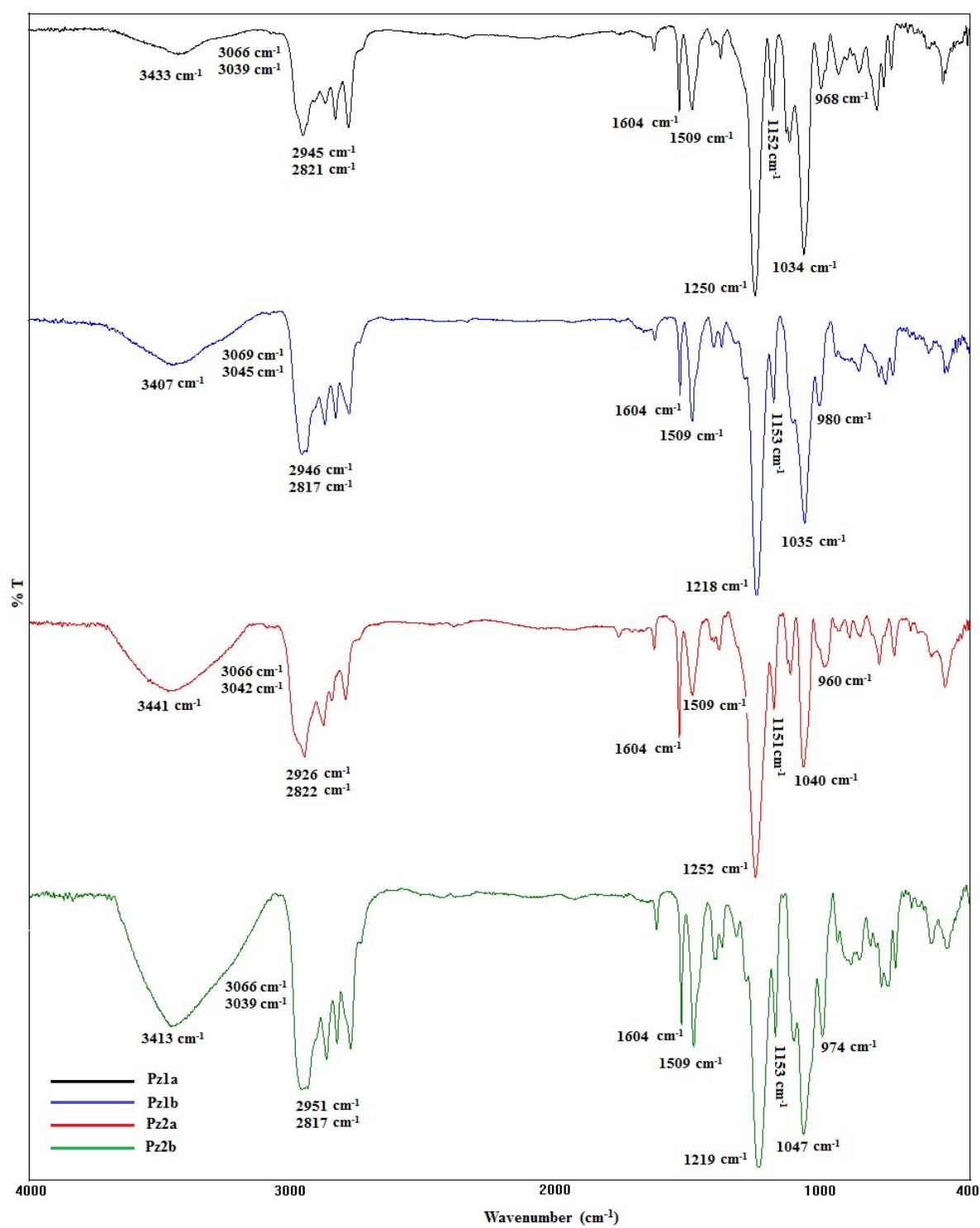
**Fig. S1** The  $^{31}P$  NMR spectra of **Pz1a-Pz2b**



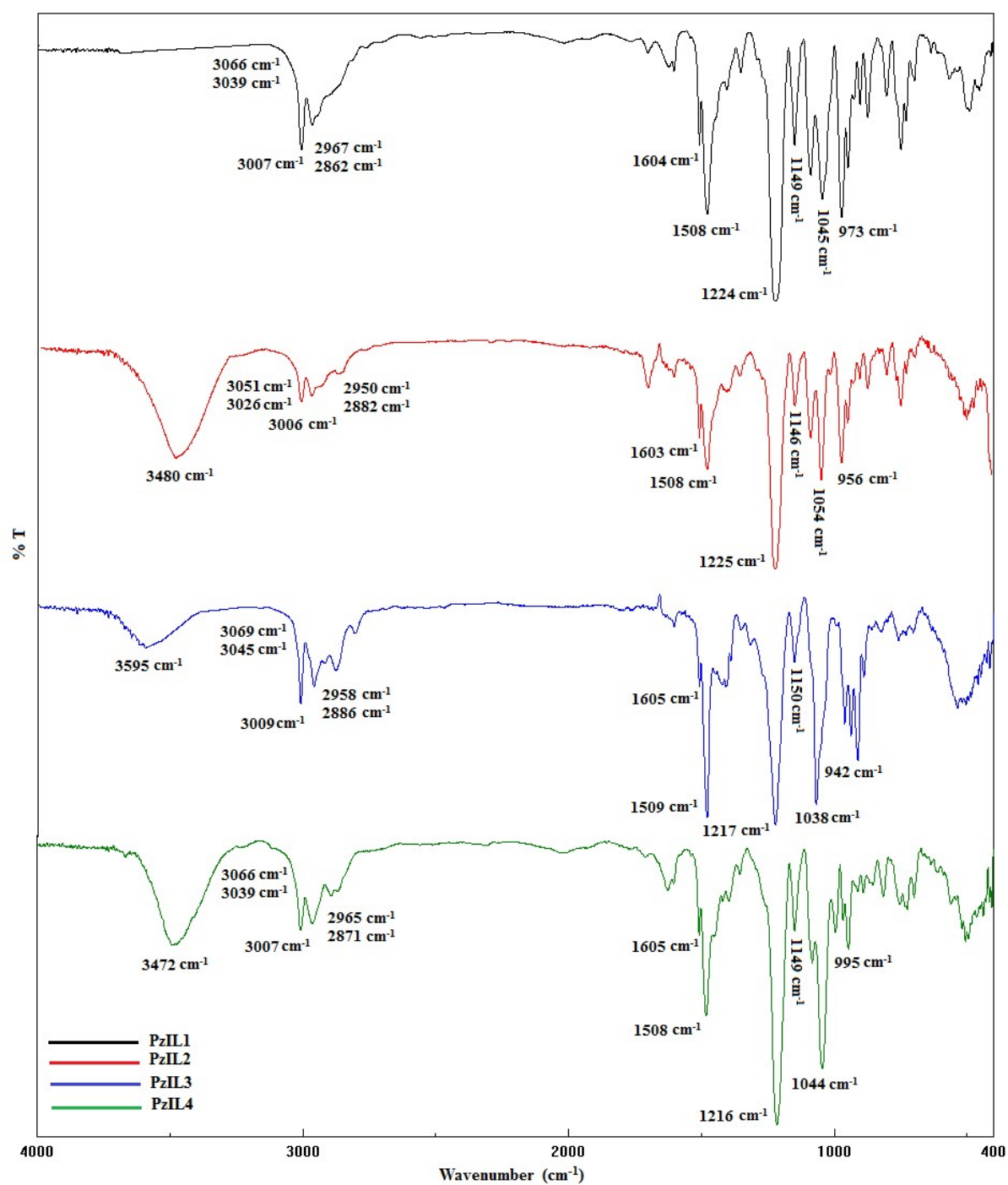
**Fig. S2** The  $^{31}\text{P}$  NMR spectra of PzIL1-PzIL4



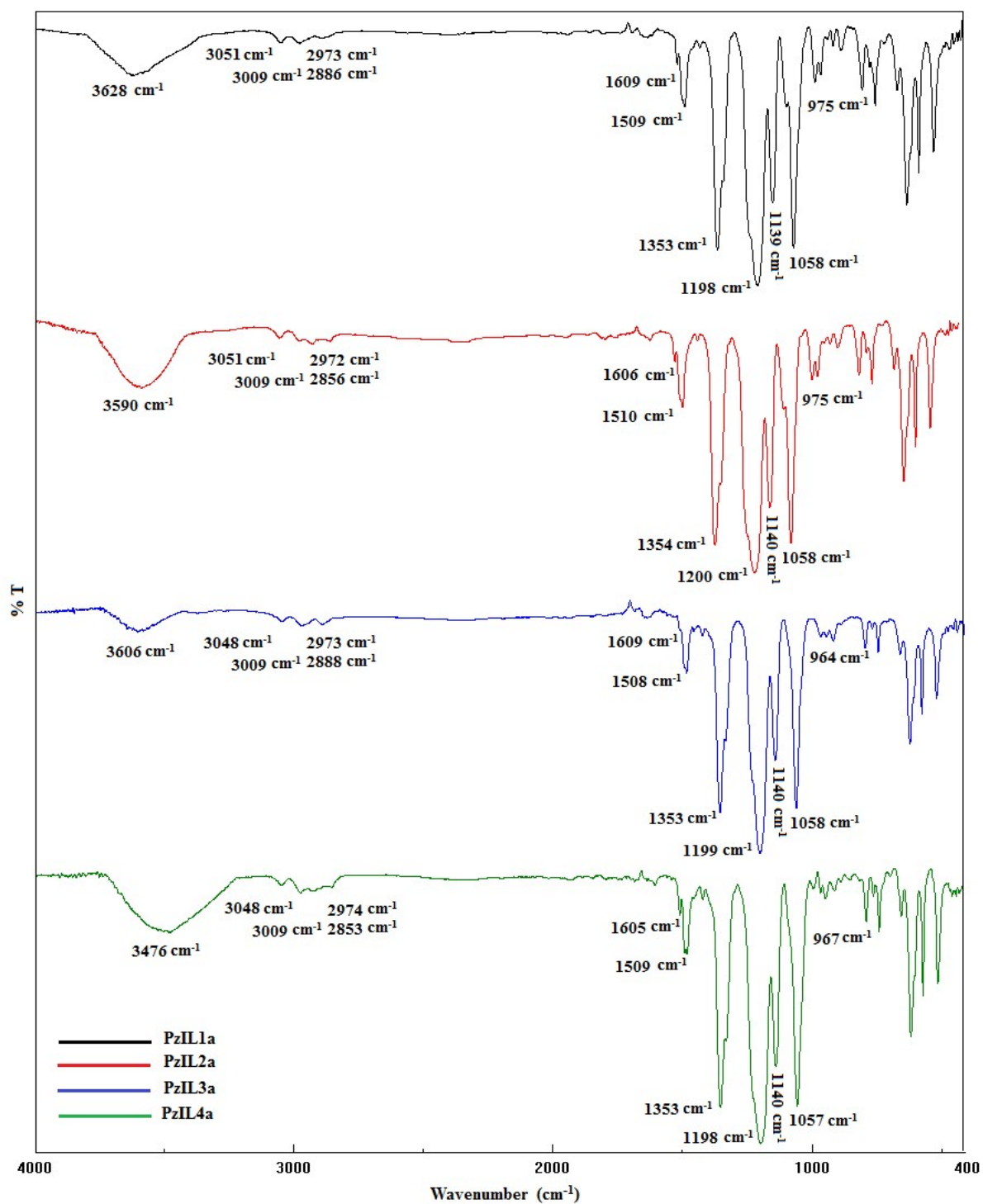
**Fig. S3** The  $^{31}\text{P}$  NMR spectra of PzIL1a-PzIL4a



**Fig. S4** The IR spectra of **Pz1a-Pz2b**

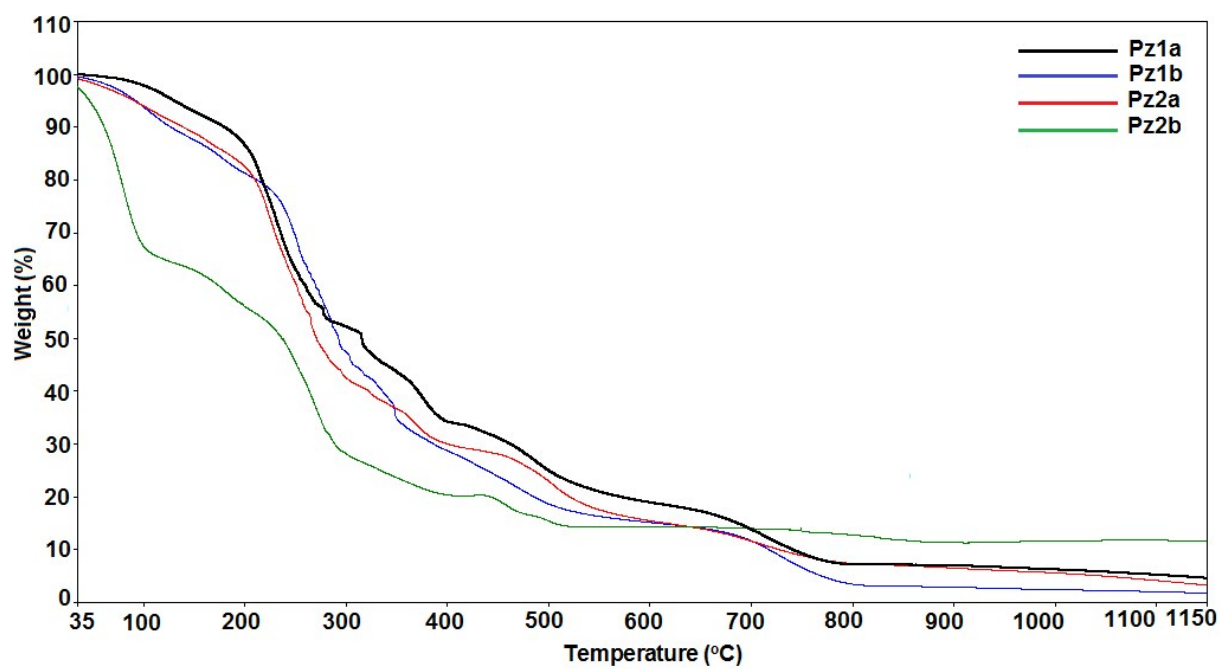


**Fig. S5** The IR spectra of PzIL1-PzIL4

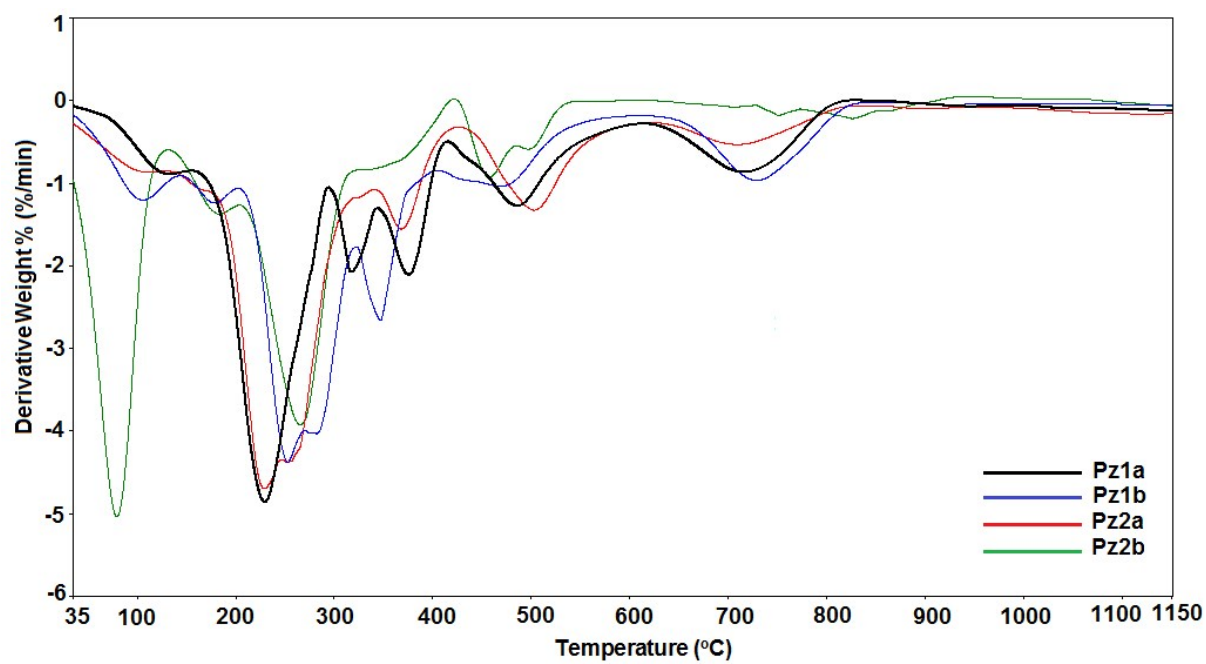


**Fig. S6** The IR spectra of **Pz1L1a-Pz1L4a**

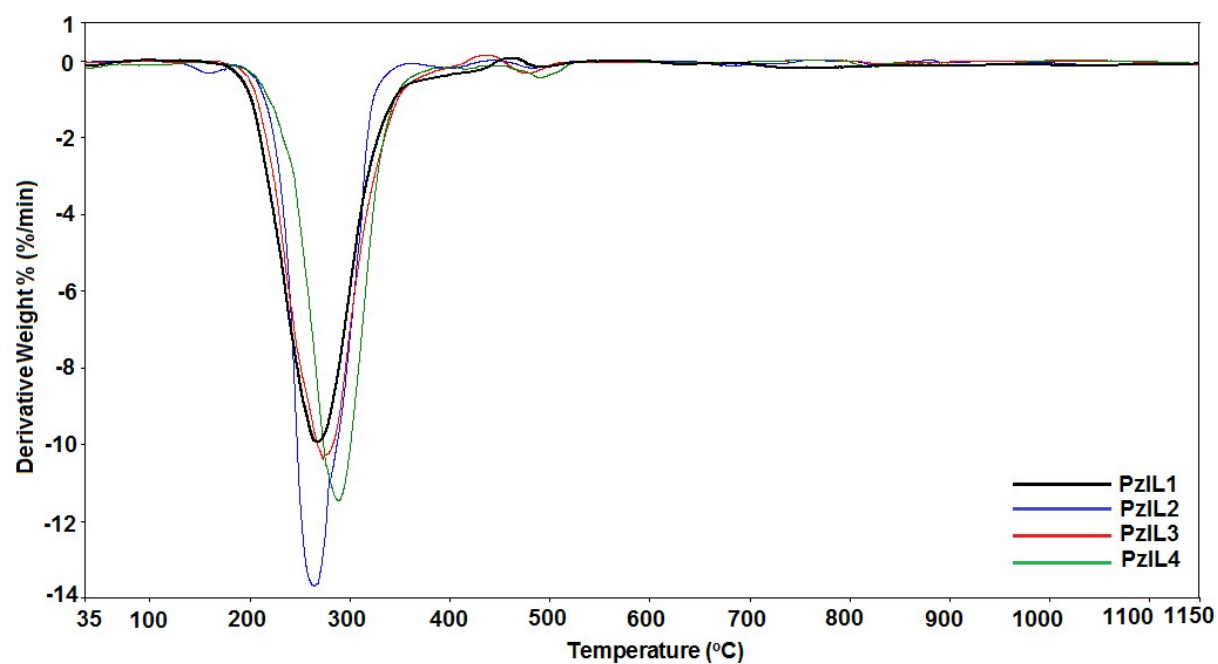




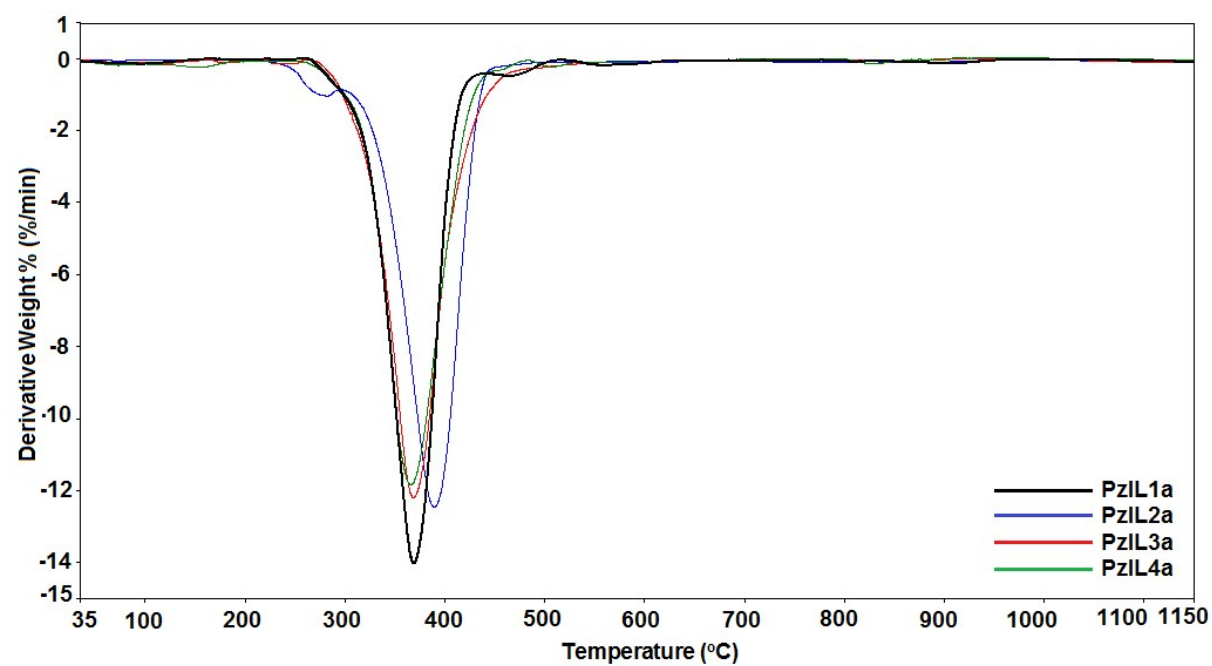
**Fig. S7** The TG curves of **Pz1a-Pz2b**



**Fig. S8** The DTG curves of **Pz1a-Pz2b**



**Fig. S9** The DTG curves of **PzIL1-PzIL4**



**Fig. S10** The DTG curves of **PzIL1a-PzIL4a**