

**Synthesis of 1,2,4,5-tetrasubstituted imidazole derivatives using novel nanostructured molten salt 2,6-dimethylpyridinium trinitromethanide {[2,6-DMPyH]C(NO<sub>2</sub>)<sub>3</sub>} as an eco-friendly and green catalyst**

Mohammad Ali Zolfigol,<sup>\*a</sup> Saeed Baghery,<sup>a</sup> Ahmad Reza Moosavi-Zare,<sup>\*b</sup> Seyed Mohammad Vahdat<sup>c</sup>

<sup>a</sup> Faculty of Chemistry, Bu-Ali Sina University, Hamedan 6517838683, Iran

<sup>b</sup> Department of Chemistry, University of Sayyed Jamaledin Asadabadi, Asadabad 6541835583, Iran

<sup>c</sup> Department of Chemistry, Ayatollah Amoli Branch, Islamic Azad University, P.O. Box 678, Amol, Iran

<sup>\*</sup>Corresponding Author: Fax: +988138257407

E-mail: zolfi@basu.ac.ir and mzolfigol@yahoo.com (M.A. Zolfigol); moosavizare@yahoo.com (A.R. Moosavi-Zare).

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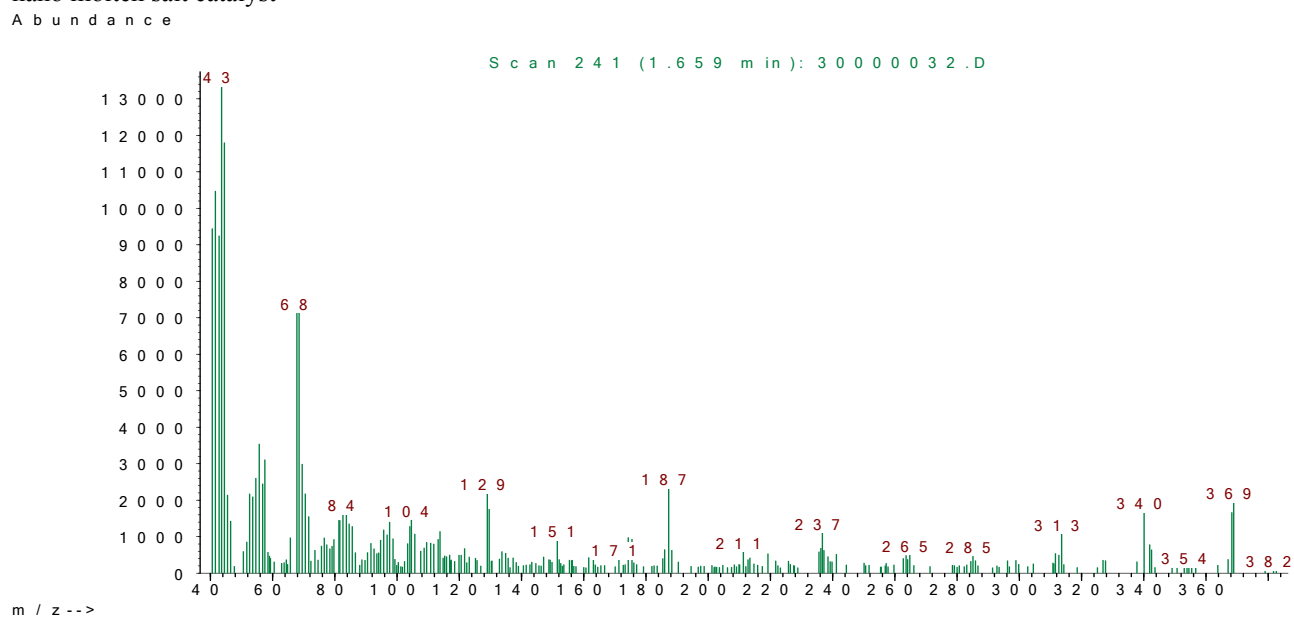
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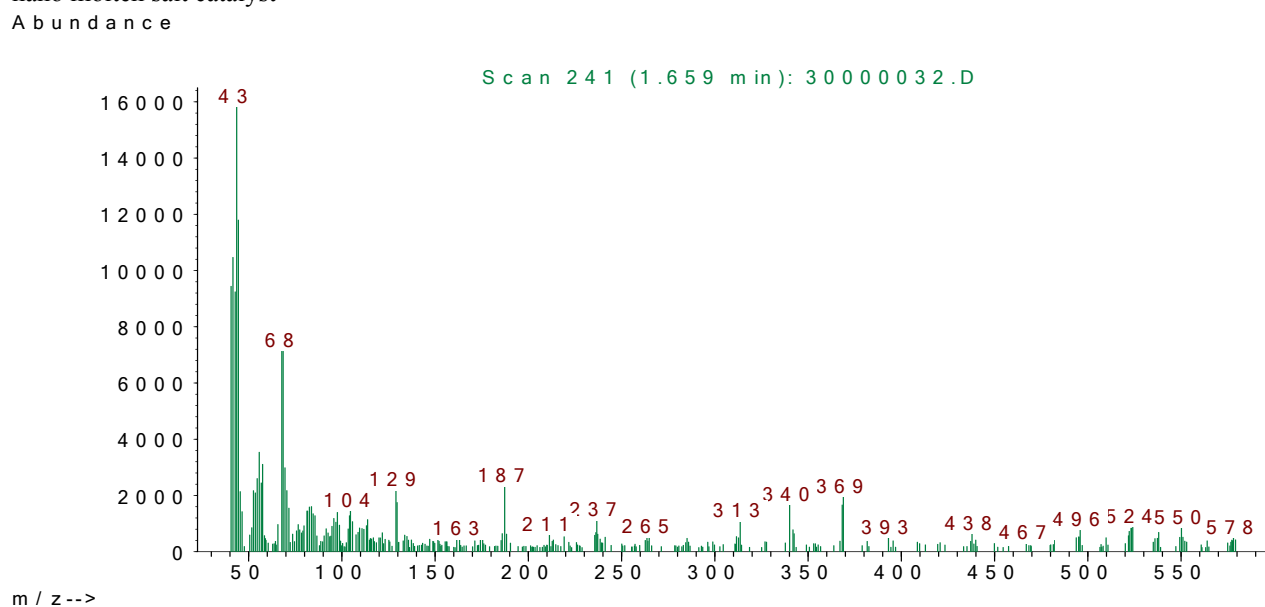
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**Supplementary data:**

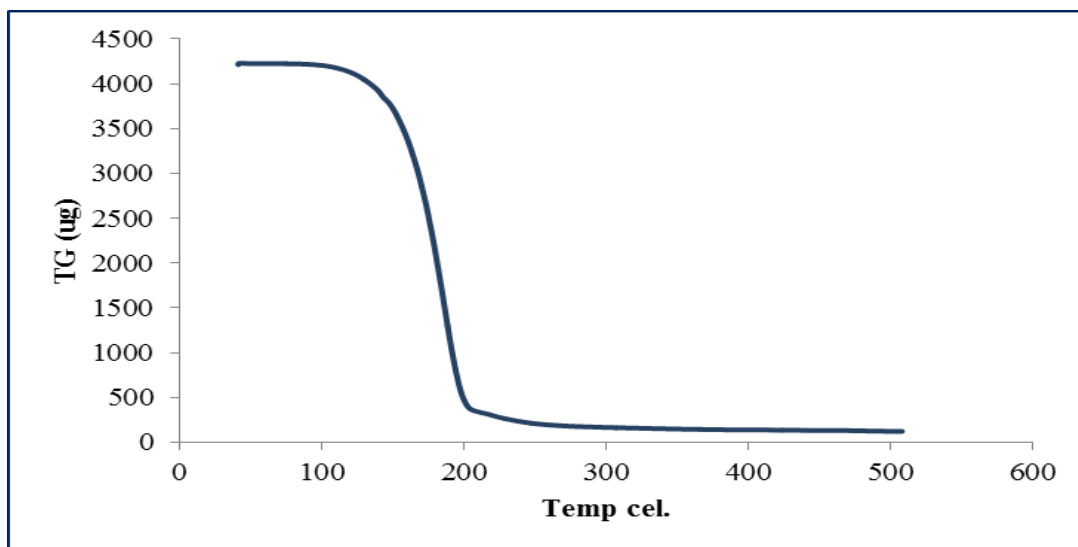
**Fig. S1.** The mass spectrum of 2,6-dimethylpyridinium trinitromethanide {[2,6-DMPyH]C(NO<sub>2</sub>)<sub>3</sub>} as a novel nano molten salt catalyst



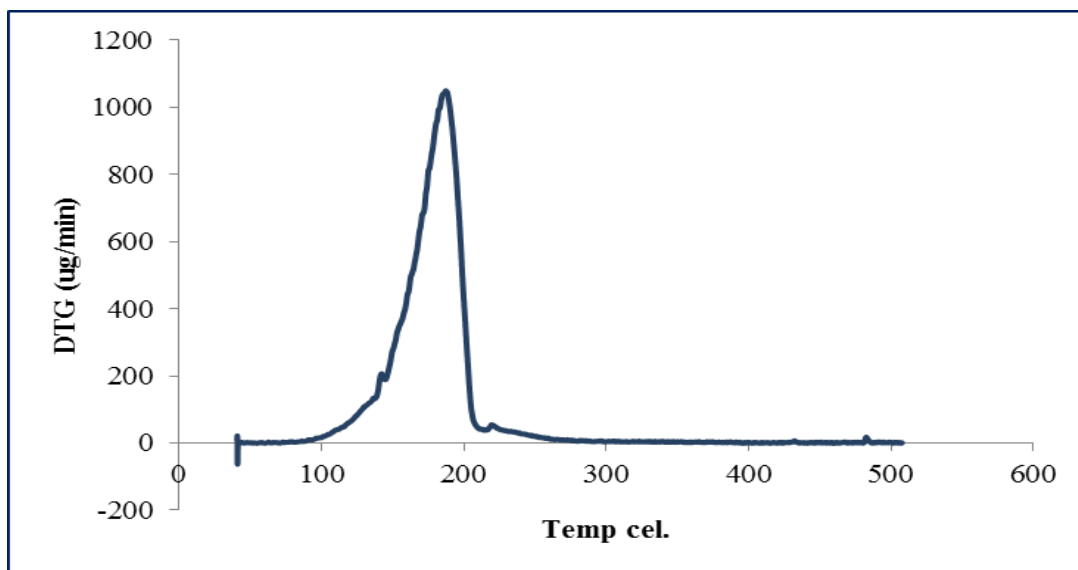
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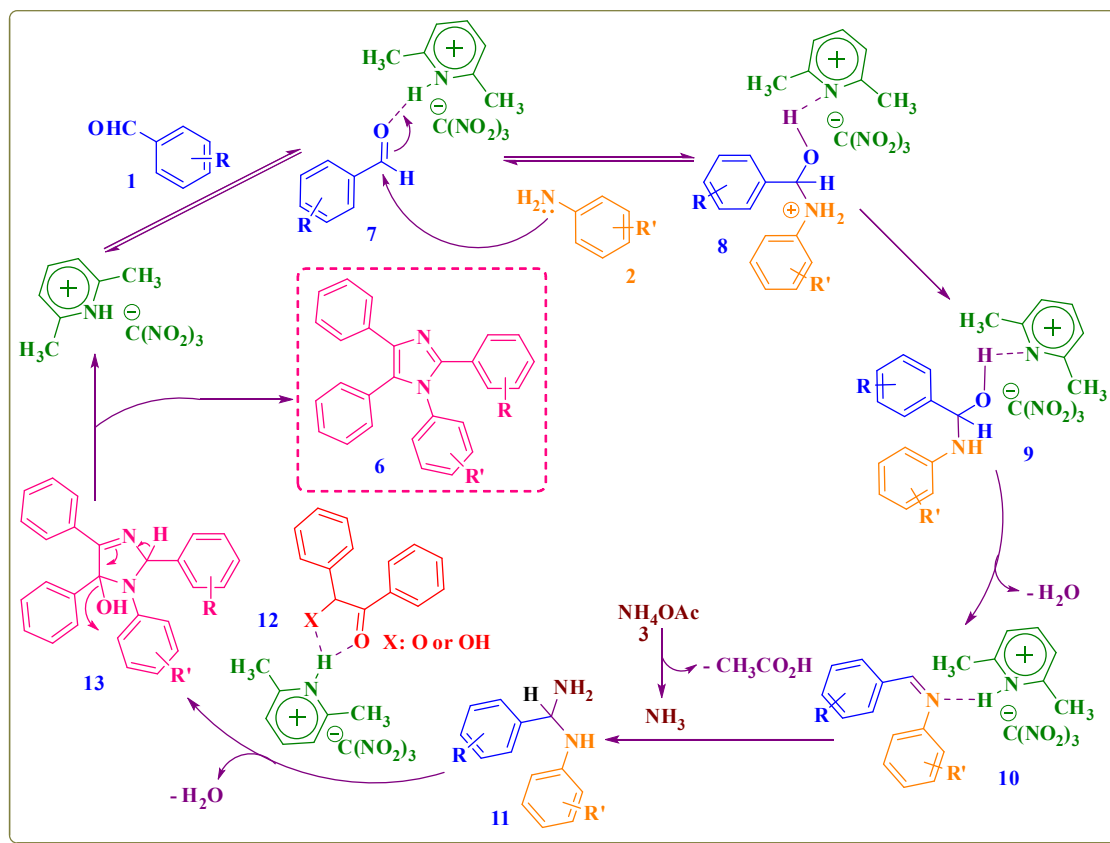
**Fig. S3.** The thermal gravimetry (TG) analysis of {[2,6-DMPyH]C(NO<sub>2</sub>)<sub>3</sub>} as a nanostructure molten salt catalyst



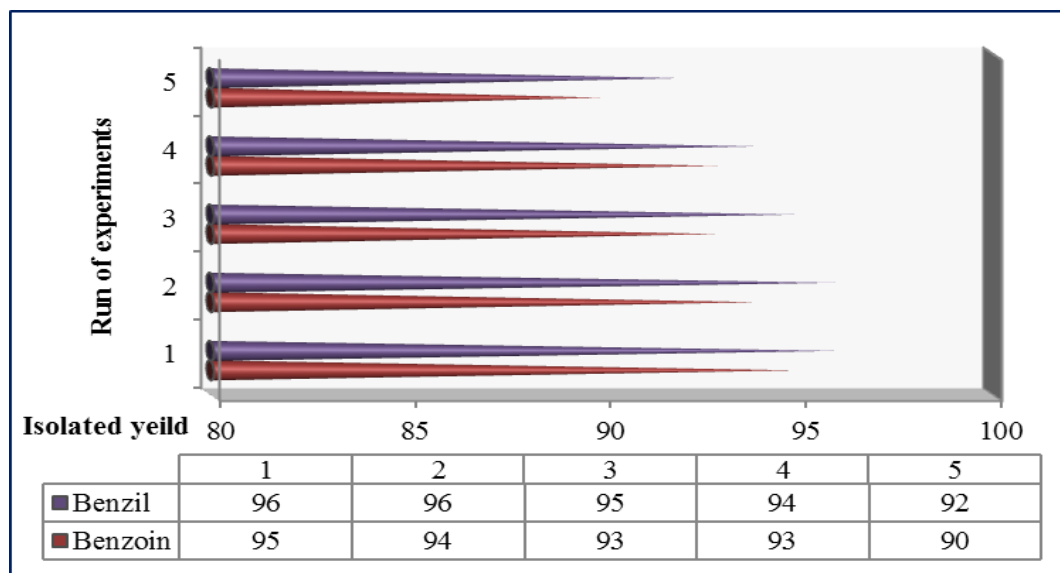
**Fig. S4.** The derivative thermal gravimetry (DTG) analysis of {[2,6-DMPyH]C(NO<sub>2</sub>)<sub>3</sub>} as a nanostructure molten salt catalyst



**Fig. S5.** Proposed mechanism for the synthesis of 1,2,4,5-tetrasubstituted imidazole derivatives in the presence of  $\{[2,6\text{-DMPyH}]\text{C}(\text{NO}_2)_3\}$  as a nanostructure MS

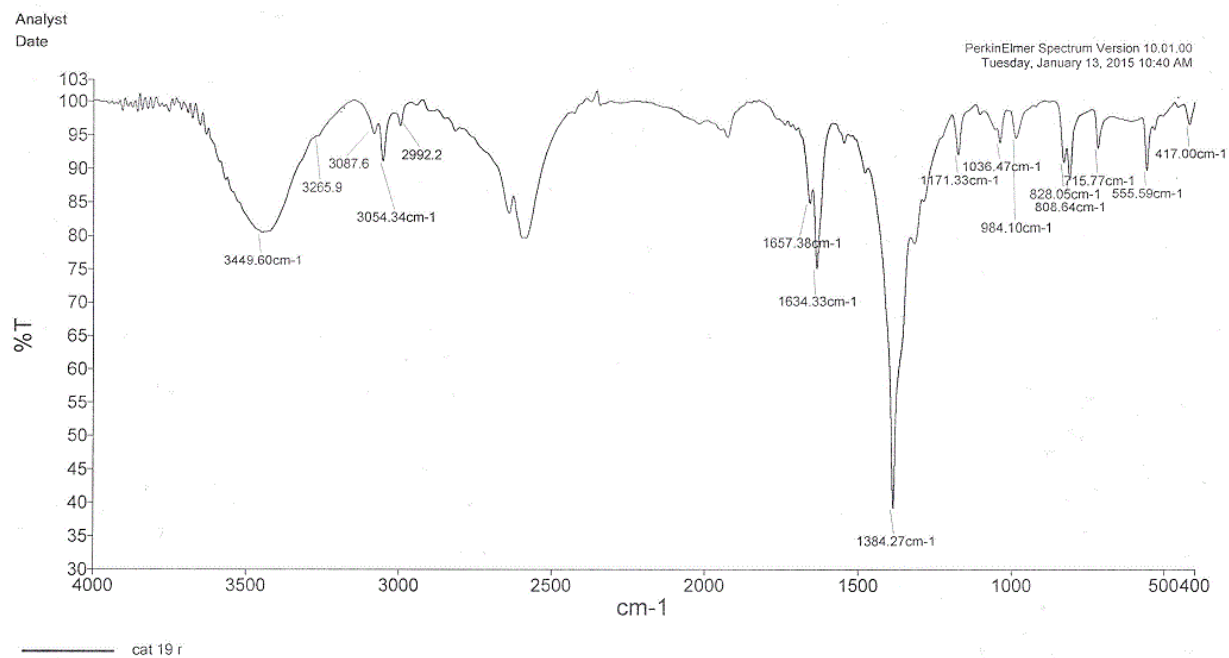


**Fig. S6.** Reusability of nanostructure MS catalyst in 6 minutes (using benzil) and 8 minutes (using benzoin)

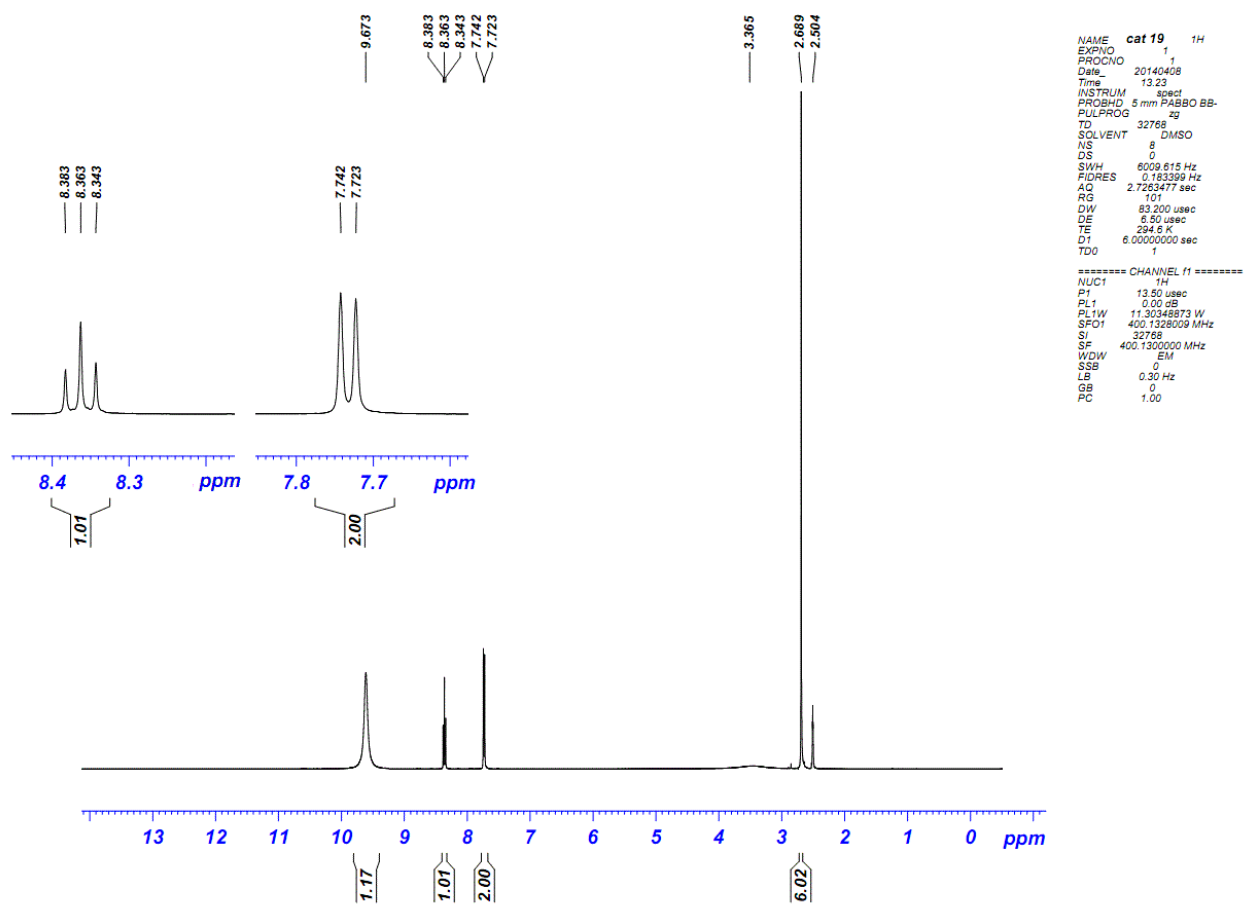




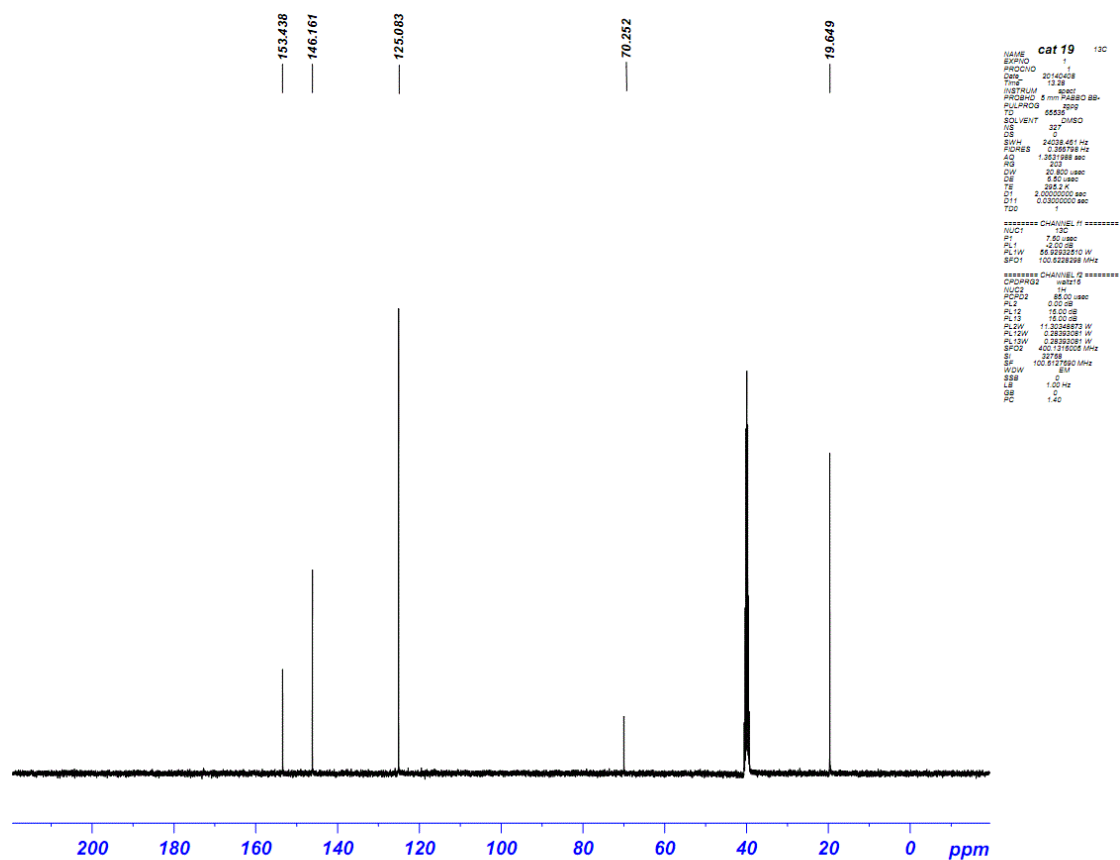
**Fig. S7.** The IR spectrum of 2,6-dimethylpyridinium trinitromethanide {[2,6-DMPyH]C(NO<sub>2</sub>)<sub>3</sub>} as a novel nano molten salt catalyst after recycling



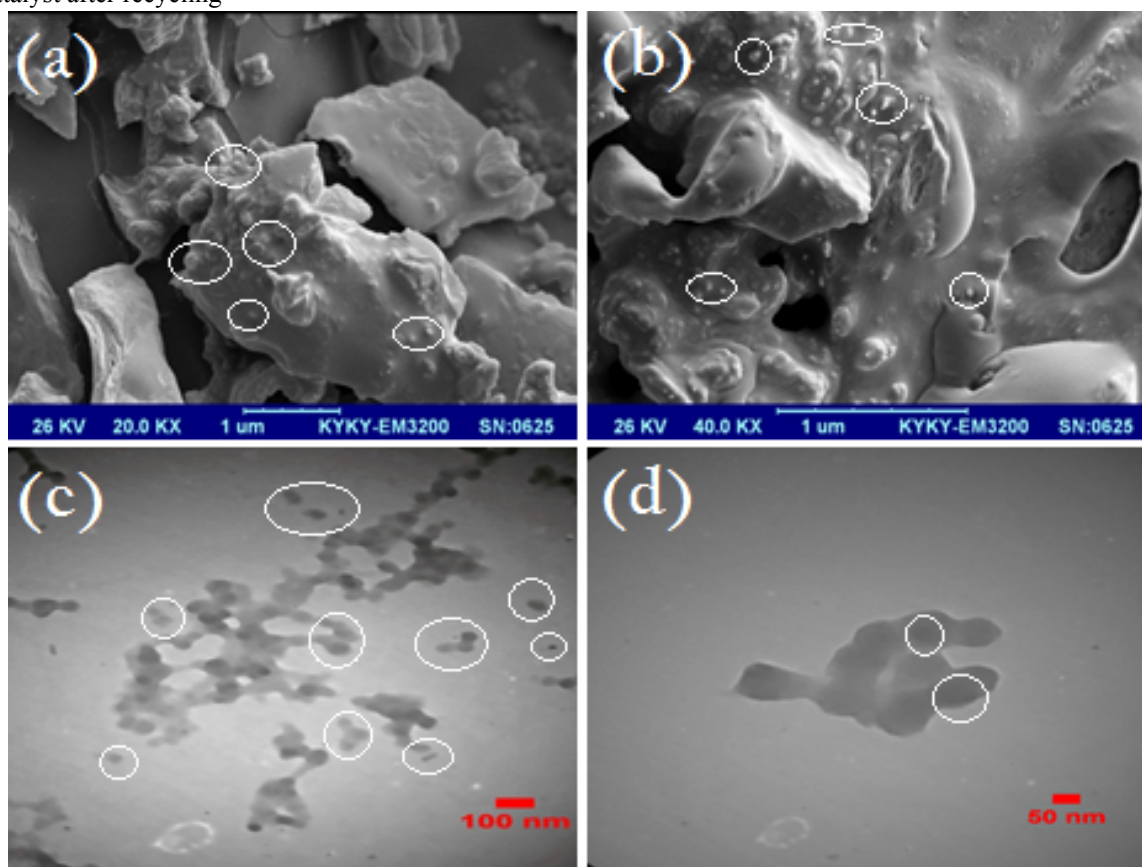
**Fig. S8.** The  $^1\text{H}$  NMR spectrum of 2,6-dimethylpyridinium trinitromethanide  $\{[2,6\text{-DMPyH}]\text{C}(\text{NO}_2)_3\}$  as a novel nano molten salt catalyst after recycling



**Fig. S9.** The  $^{13}\text{C}$  NMR spectrum of 2,6-dimethylpyridinium trinitromethanide  $\{[2,6\text{-DMPyH}]\text{C}(\text{NO}_2)_3\}$  as a novel nano molten salt catalyst after recycling



**Fig. S10.** The scanning electron microscopy (SEM) (a and b) and transmission electron microscopy (TEM) (c and d) of 2,6-dimethylpyridinium trinitromethanide  $\{[2,6\text{-DMPyH}]\text{C}(\text{NO}_2)_3\}$  as a novel nano molten salt catalyst after recycling



**Fig. S11.** The IR spectrum of 2-(4-nitrophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 1)

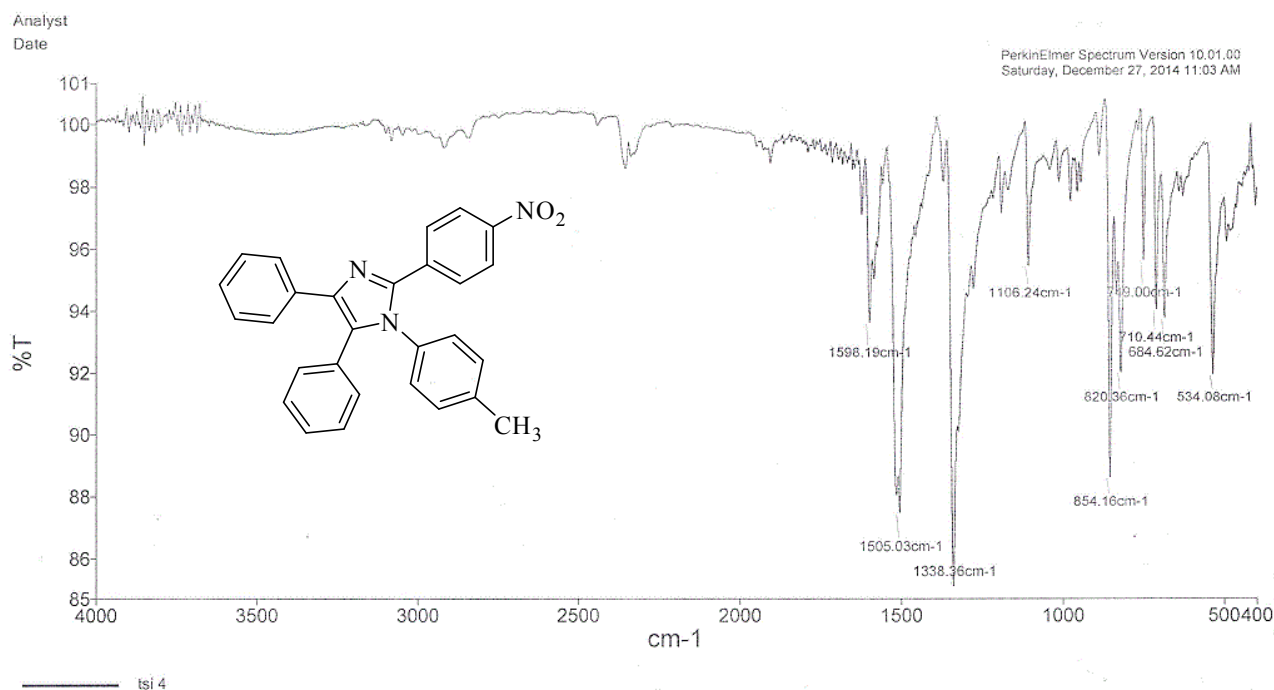


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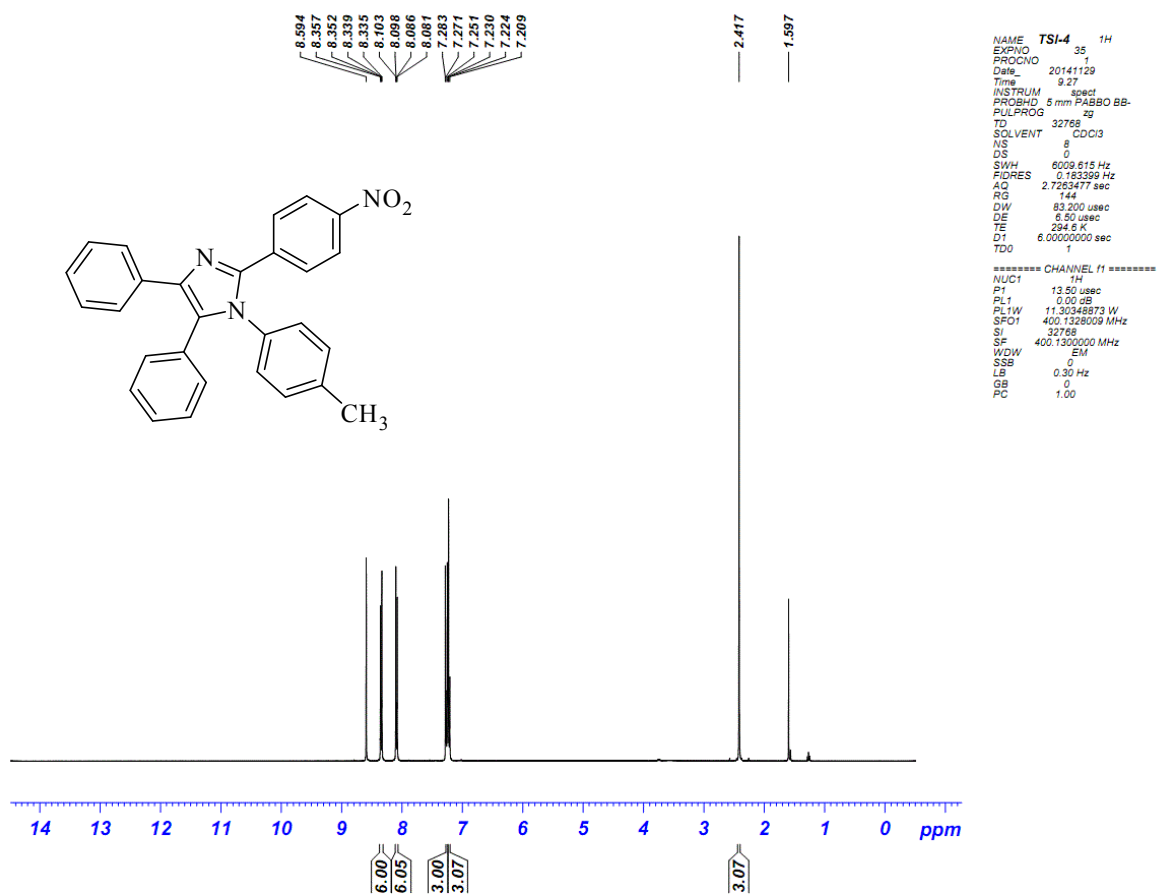


Fig. S13. The <sup>1</sup>H NMR spectrum of 2-(4-nitrophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 1)

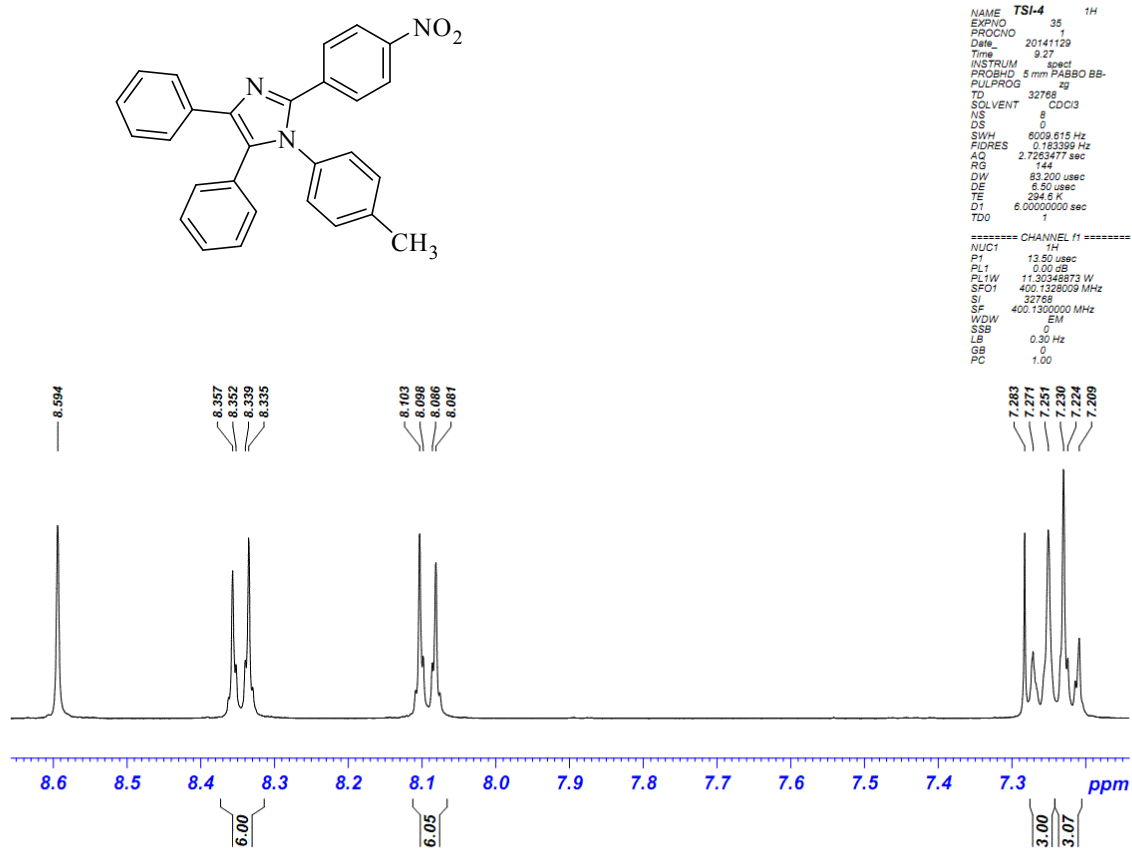
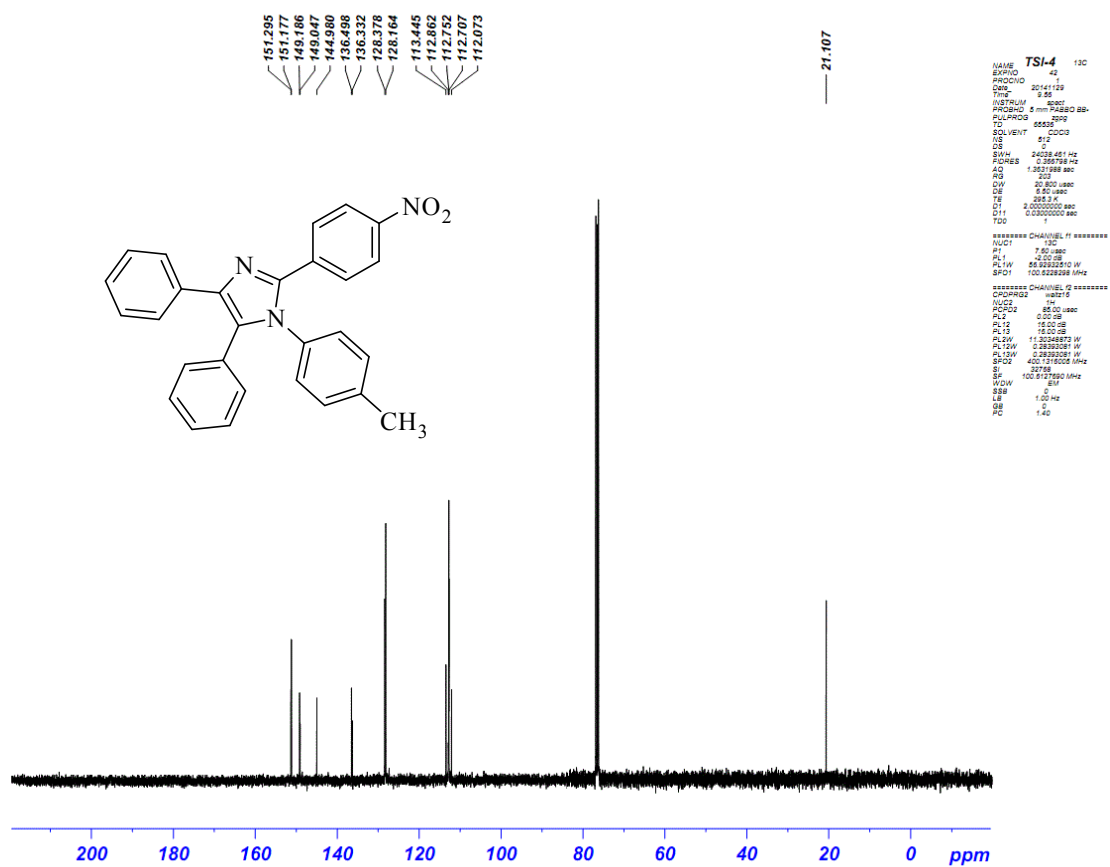
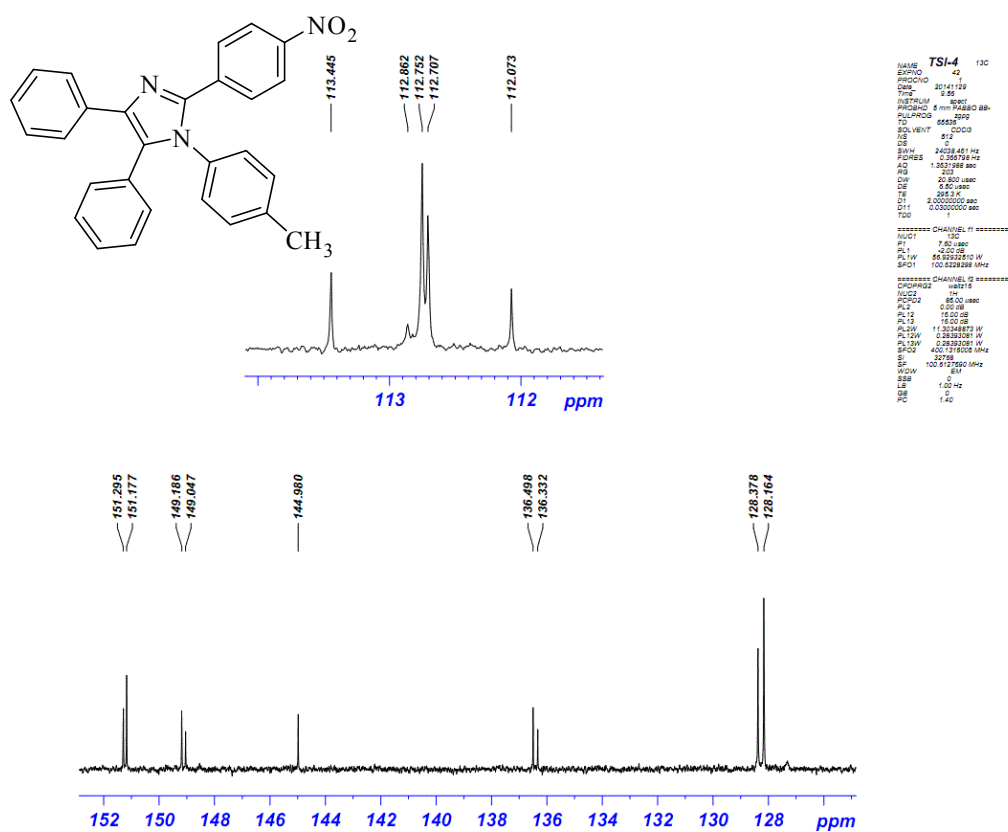


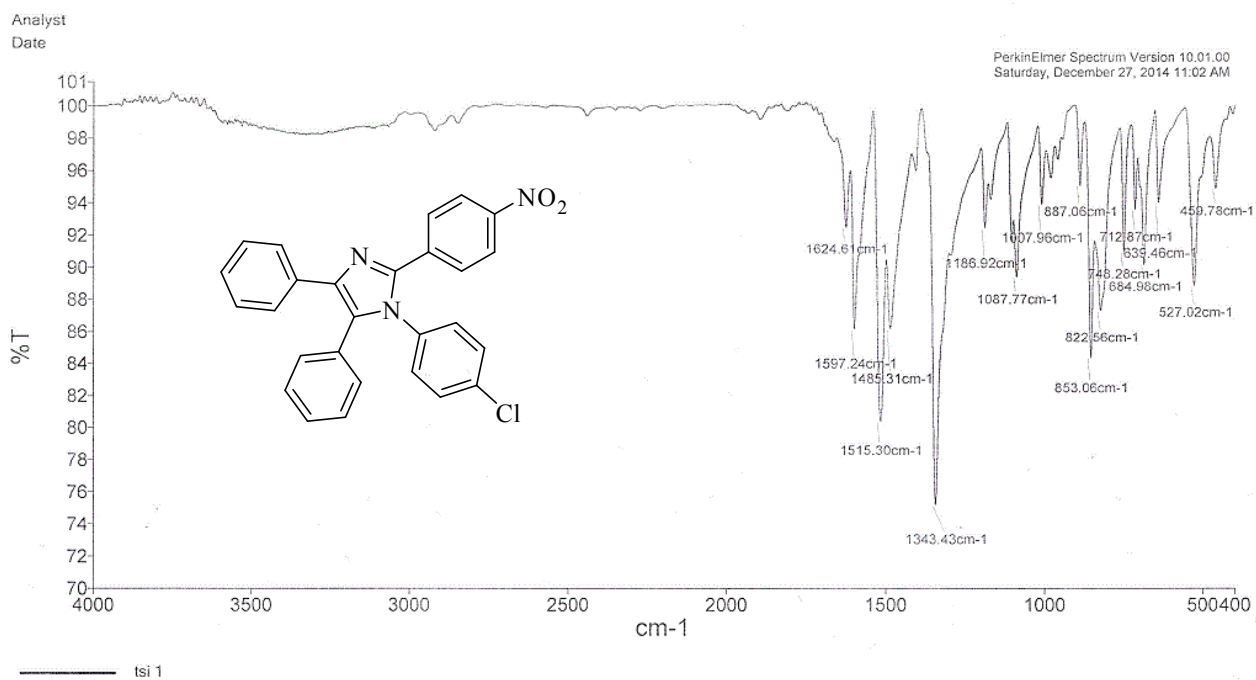
Fig. S14. The  $^{13}\text{C}$  NMR spectrum of 2-(4-nitrophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 1)



**Fig. S15.** The <sup>13</sup>C NMR spectrum of 2-(4-nitrophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 1)

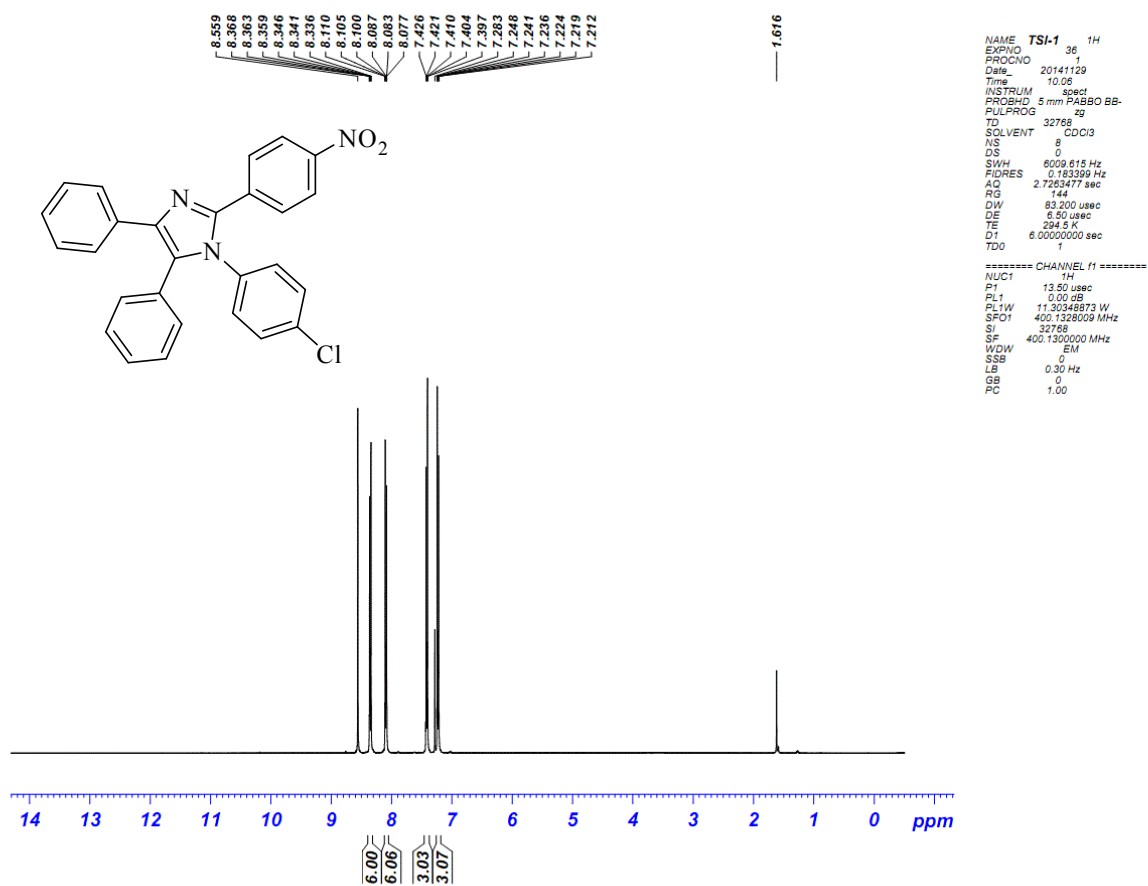


**Fig. S16.** The IR spectrum of 1-(4-chlorophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 2)

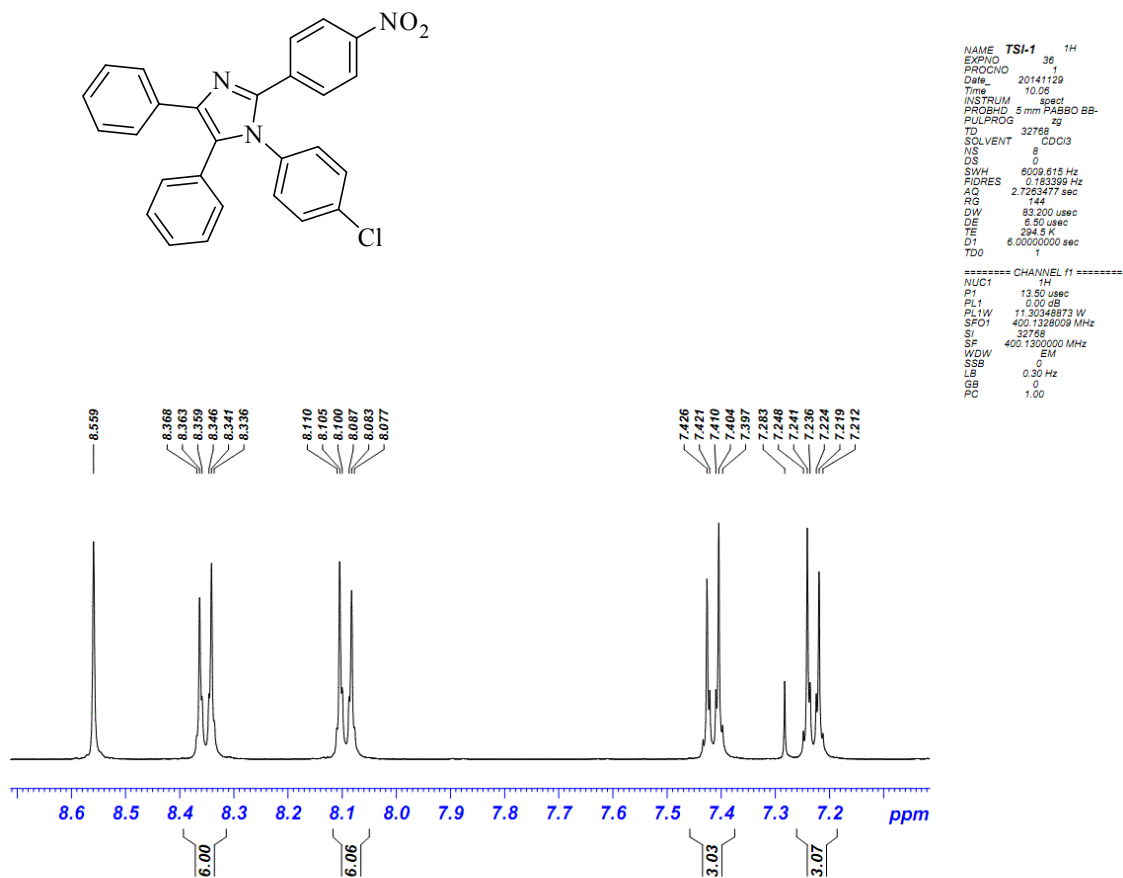




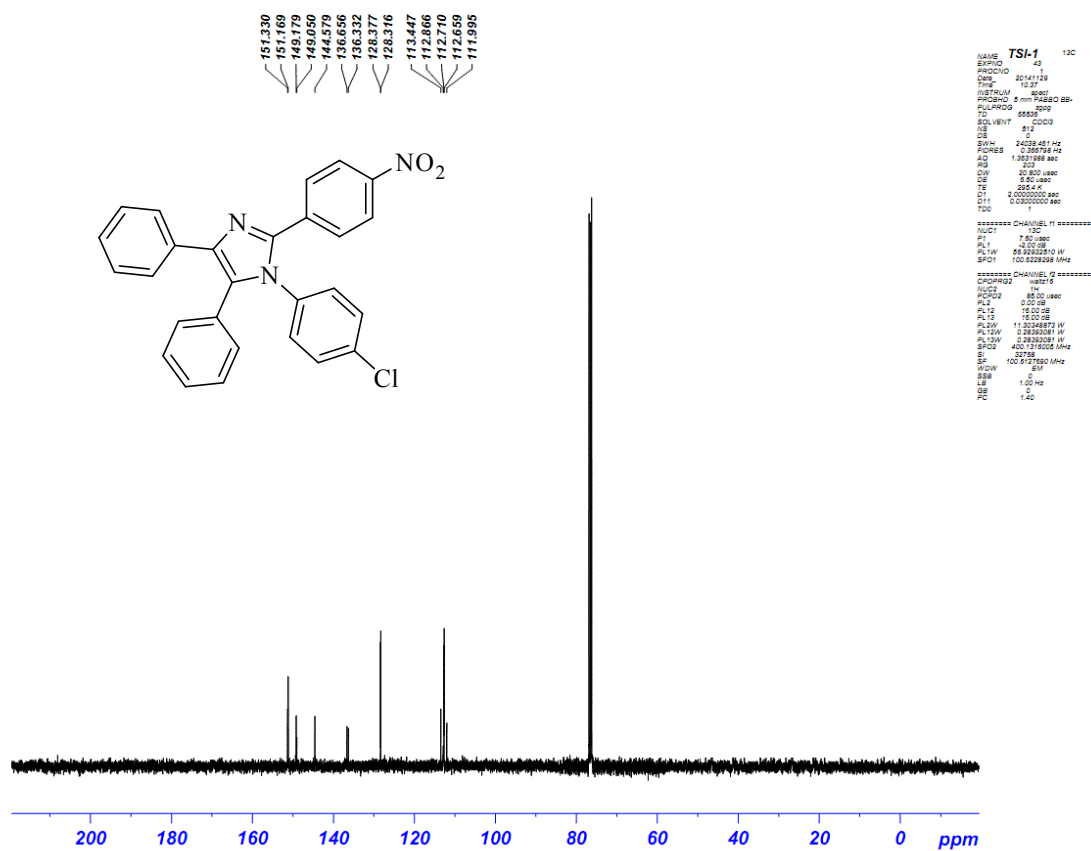
**Fig. S17.** The  $^1\text{H}$  NMR spectrum of 1-(4-chlorophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 2)



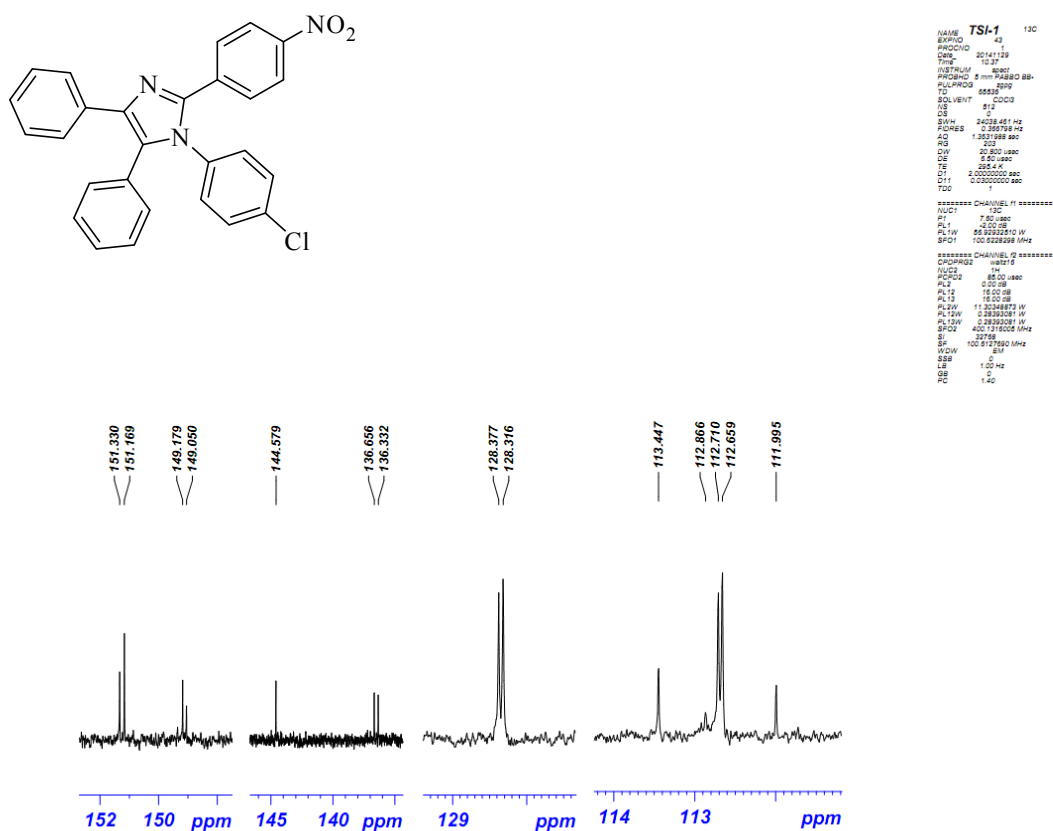
**Fig. S18.** The  $^1\text{H}$  NMR spectrum of 1-(4-chlorophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 2)



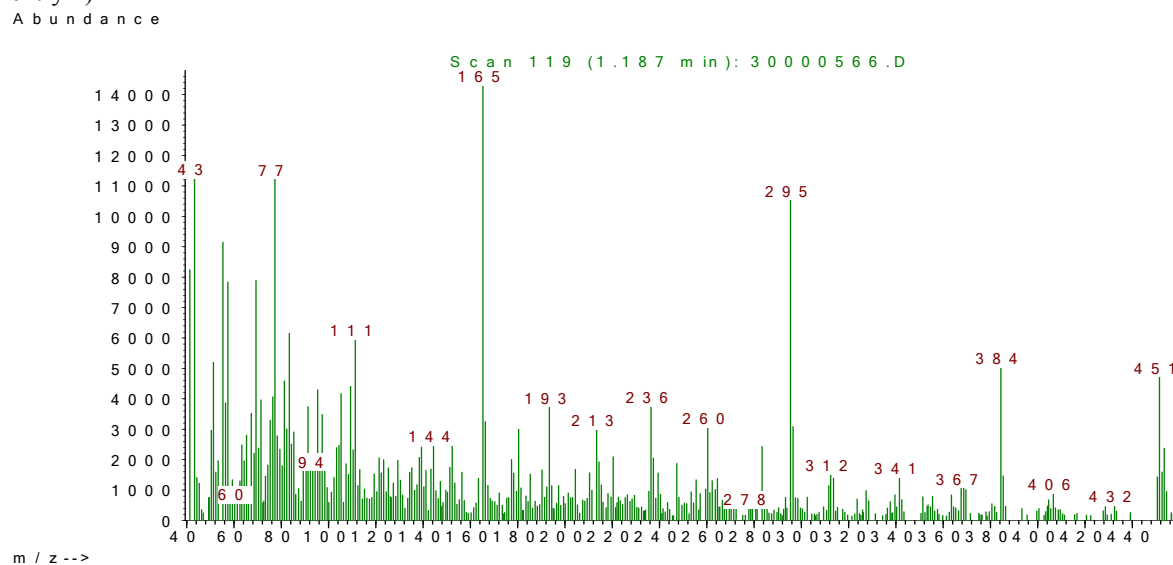
**Fig. S19.** The <sup>13</sup>C NMR spectrum of 1-(4-chlorophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1H-imidazole (Table 4, entry 2)



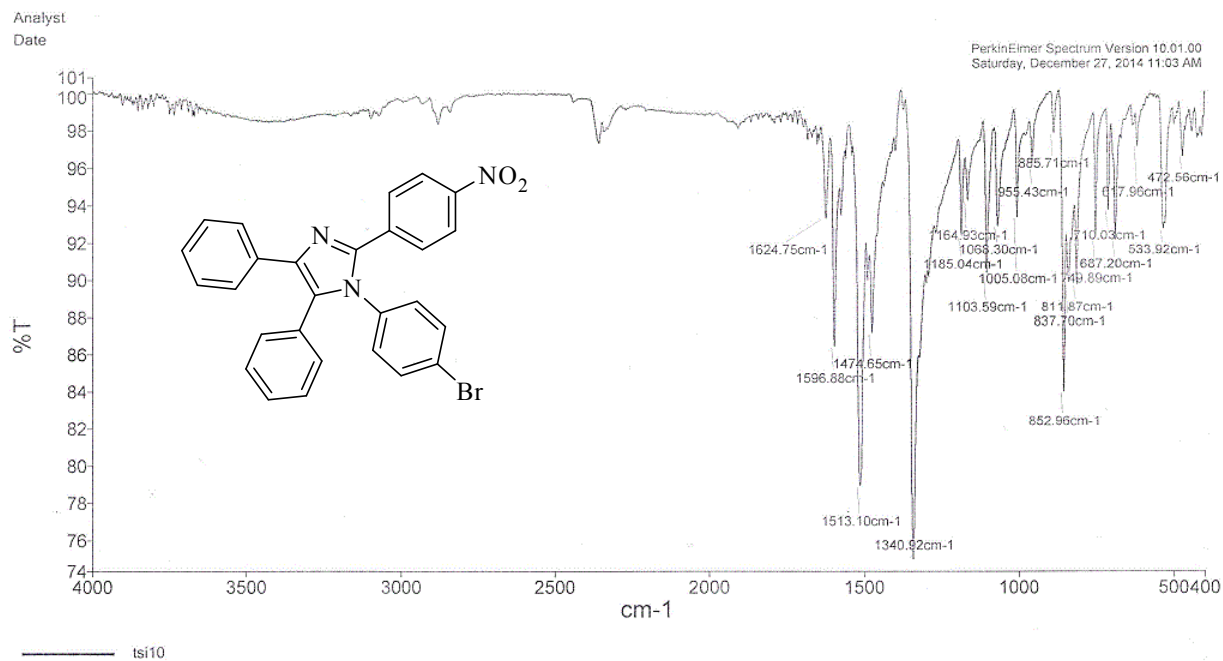
**Fig. S20.** The <sup>13</sup>C NMR spectrum of 21-(4-chlorophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 2)



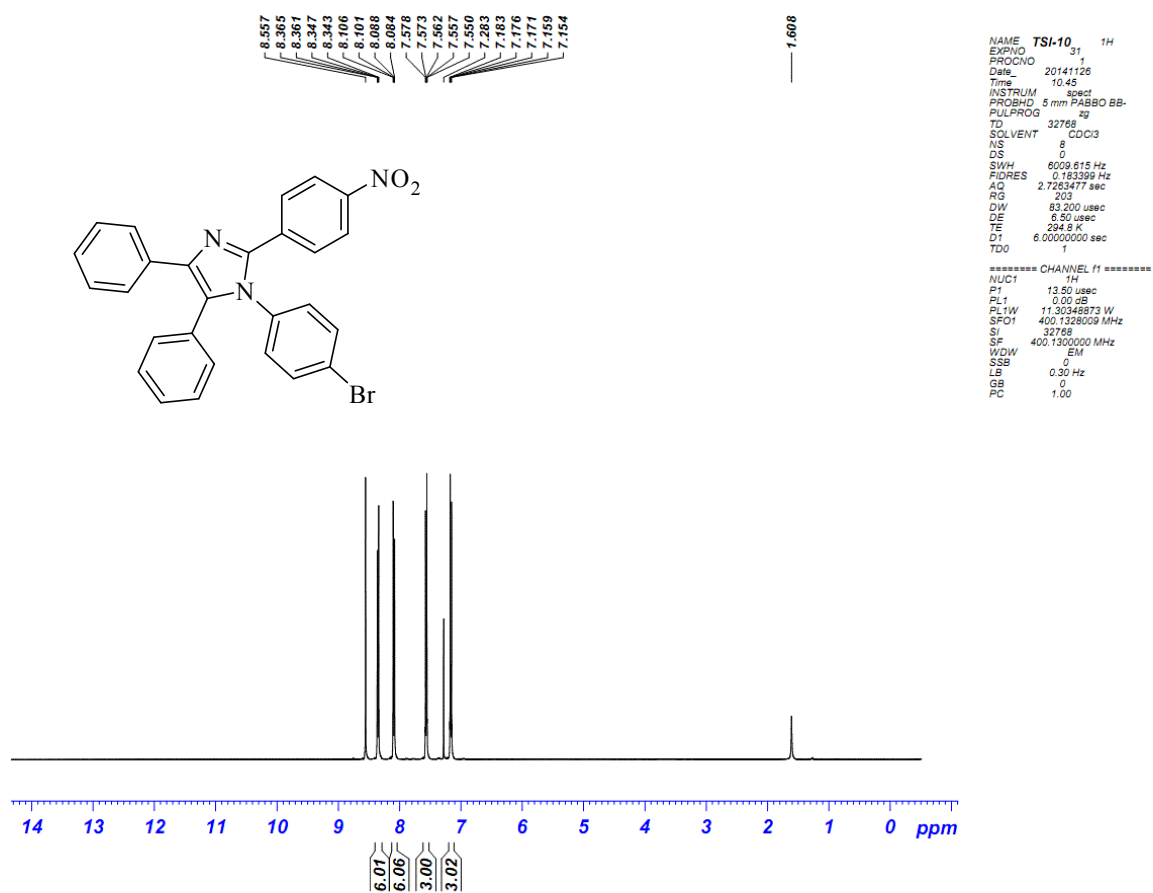
**Fig. S21.** The mass spectrum of 1-(4-chlorophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 2)



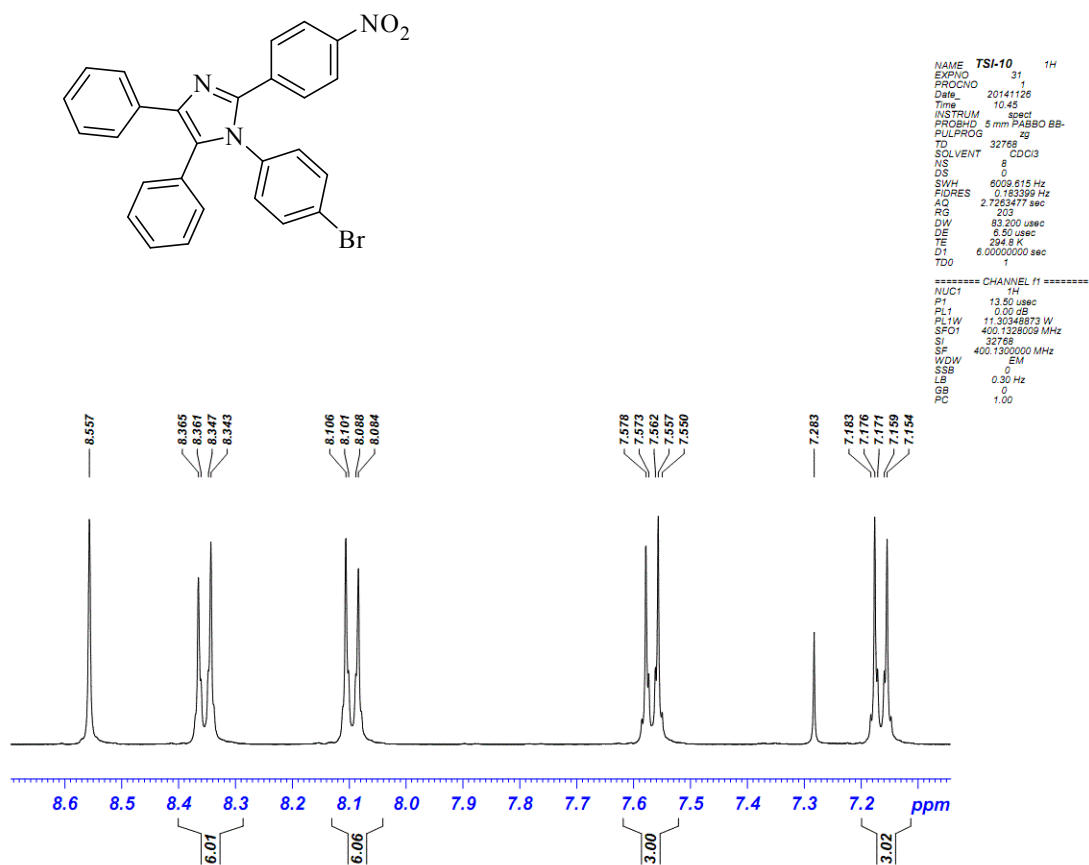
**Fig. S22.** The IR spectrum of 1-(4-bromophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 3)



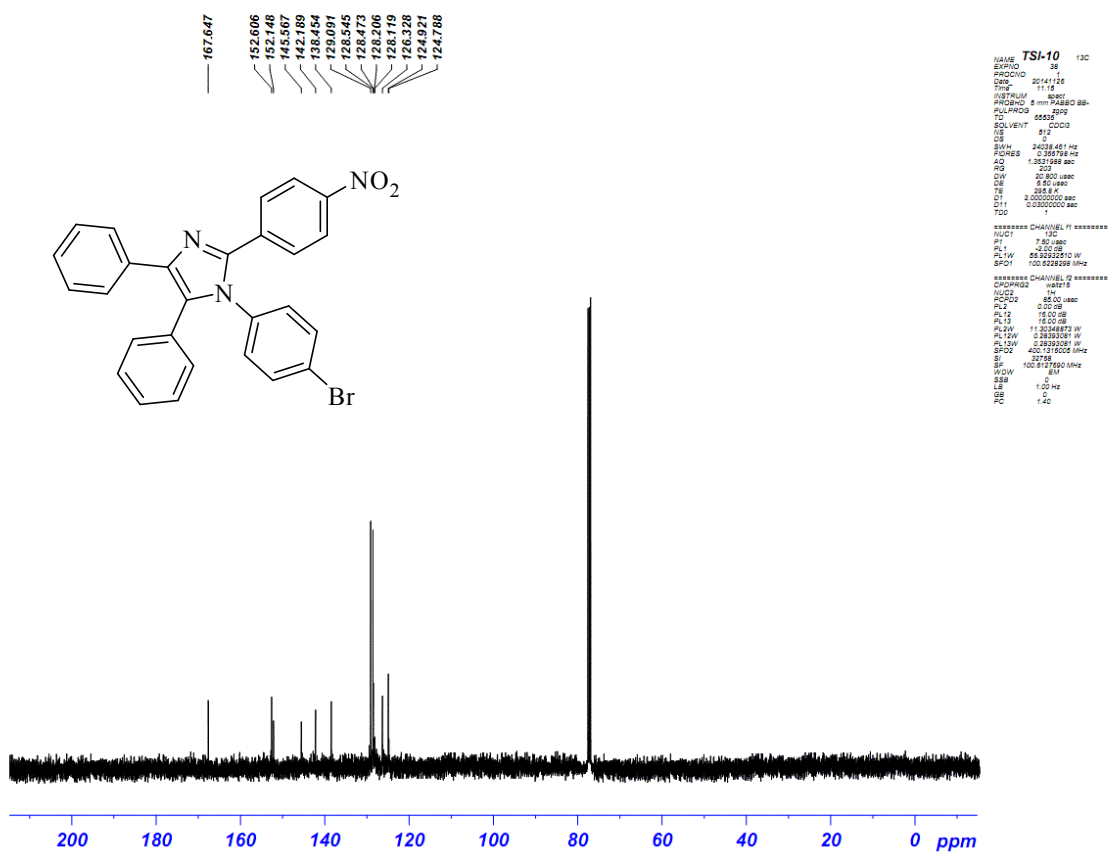
**Fig. S23.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 3)



**Fig. S24.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 3)

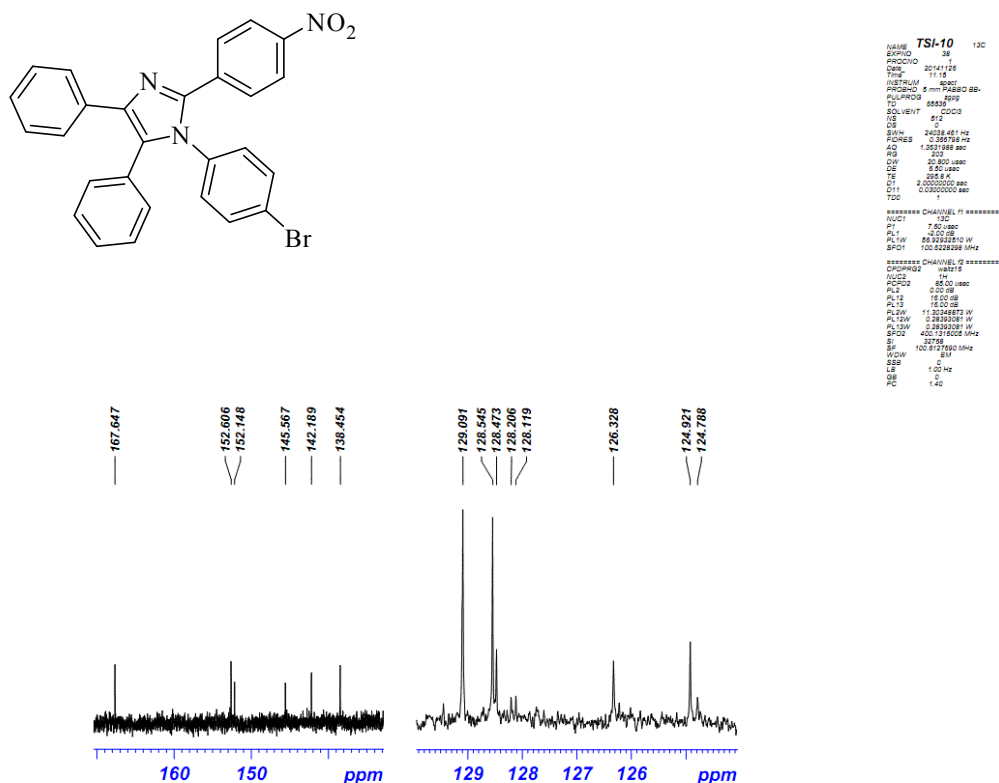


**Fig. S25.** The <sup>13</sup>C NMR spectrum of 1-(4-bromophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 3)

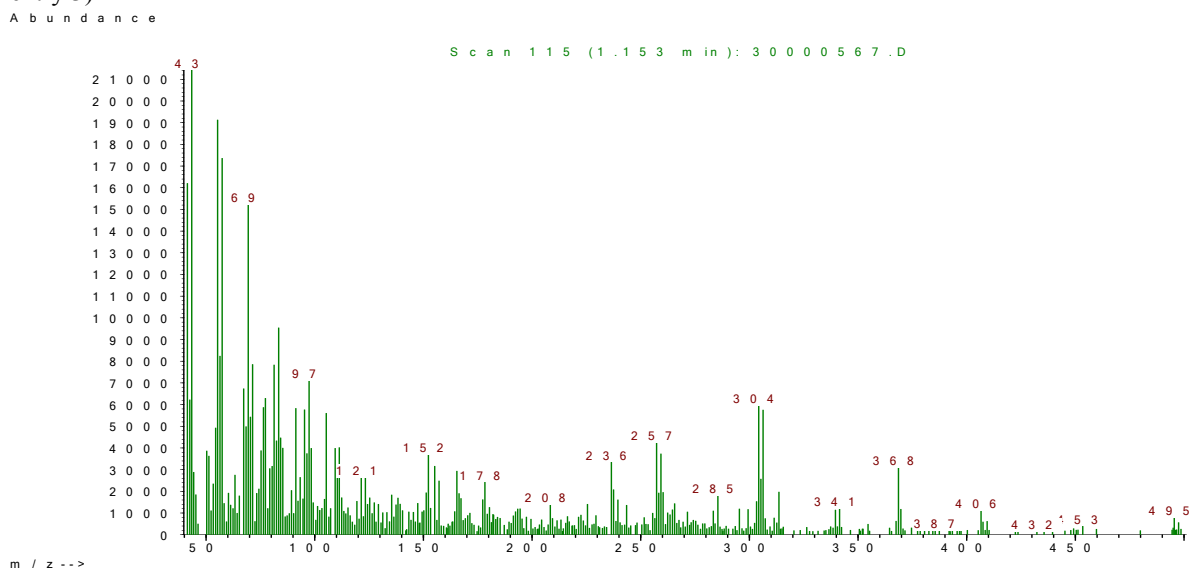




**Fig. S26.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 3)



**Fig. S27.** The mass spectrum of 1-(4-bromophenyl)-2-(4-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 3)



**Fig. S28.** The IR spectrum of 2-(4-chlorophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 4)

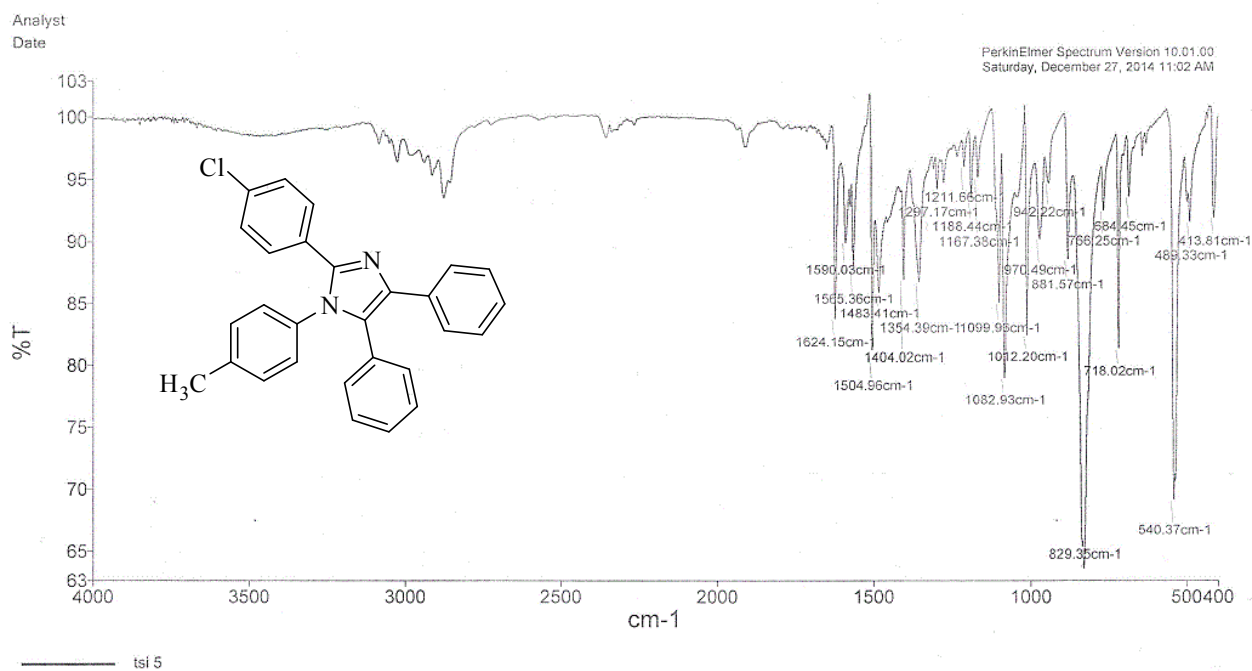


Fig. S29. The <sup>1</sup>H NMR spectrum of 2-(4-chlorophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 4)

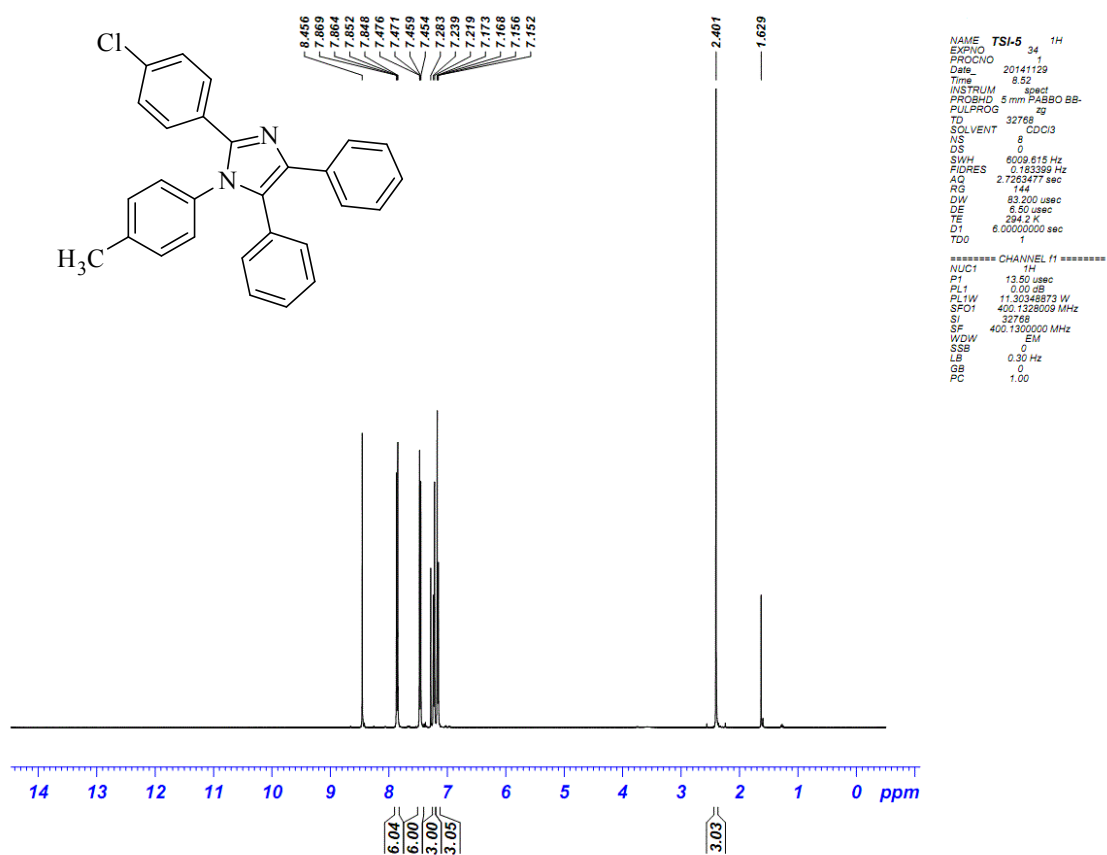


Fig. S30. The <sup>1</sup>H NMR spectrum of 2-(4-chlorophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 4)

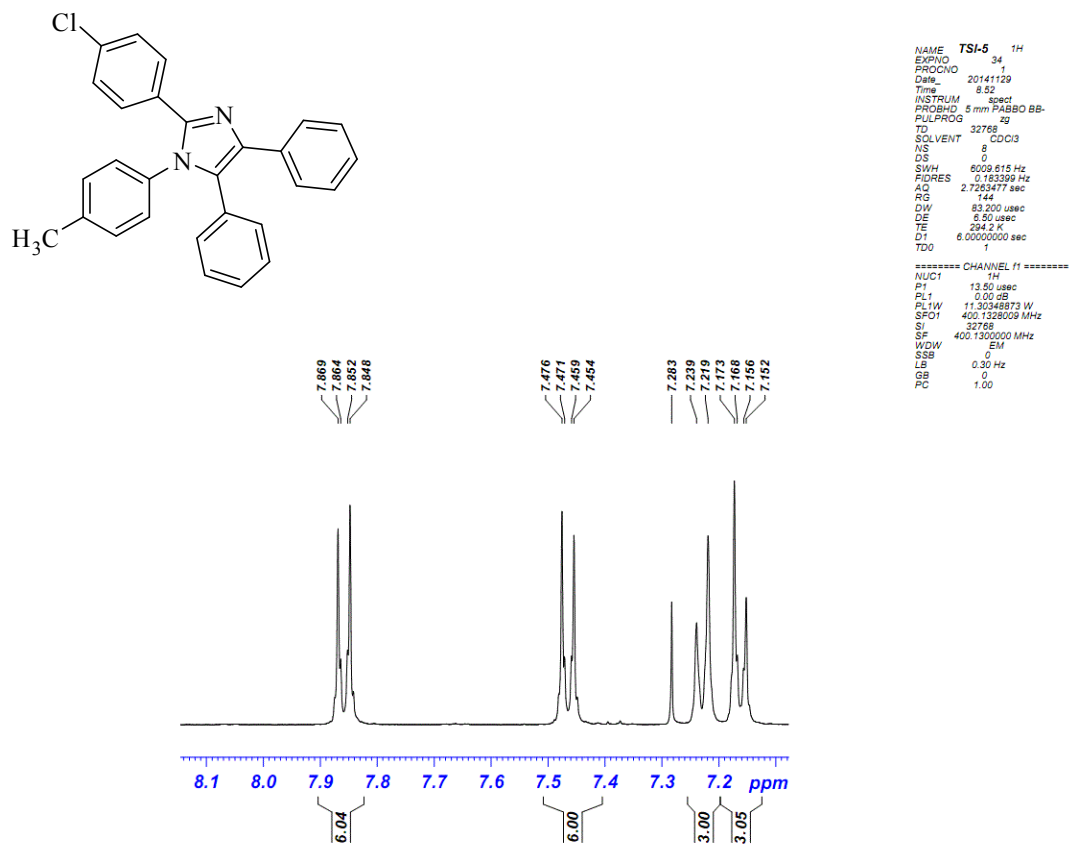


Fig. S31. The  $^{13}\text{C}$  NMR spectrum of 2-(4-chlorophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 4)

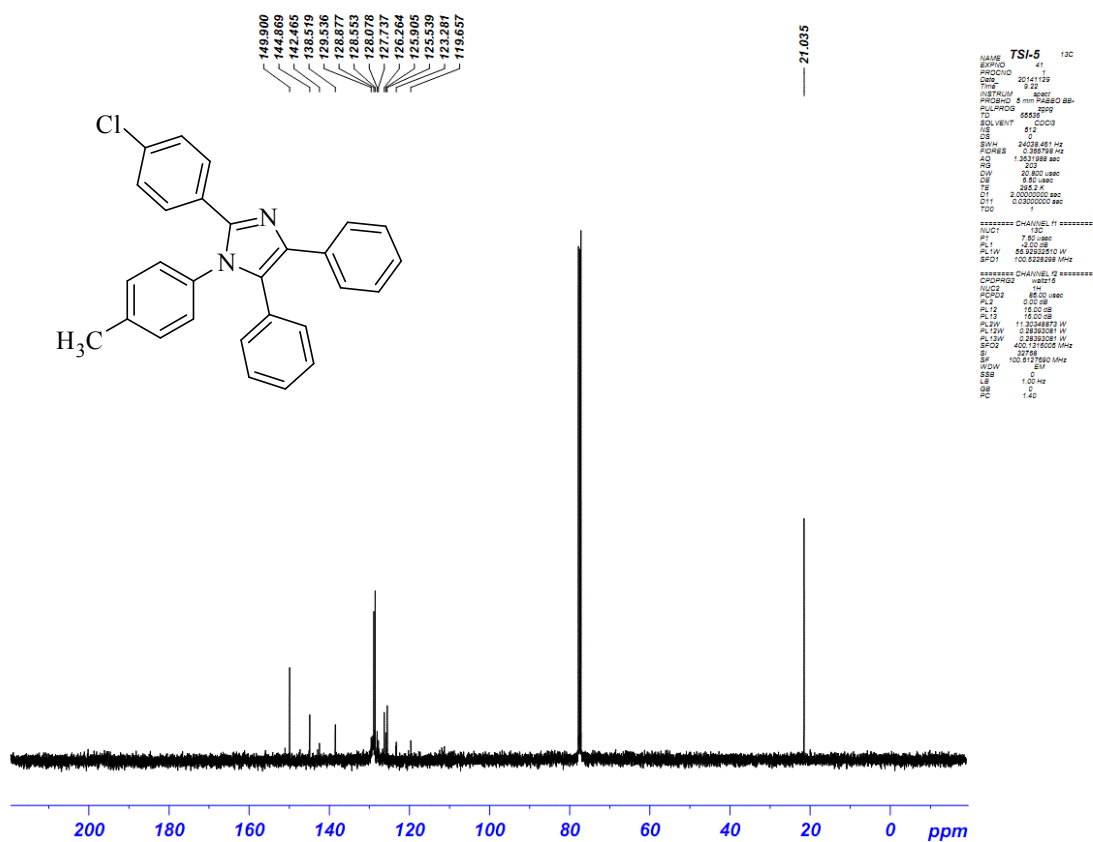


Fig. S32. The  $^{13}\text{C}$  NMR spectrum of 2-(4-chlorophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (Table 4, entry 4)

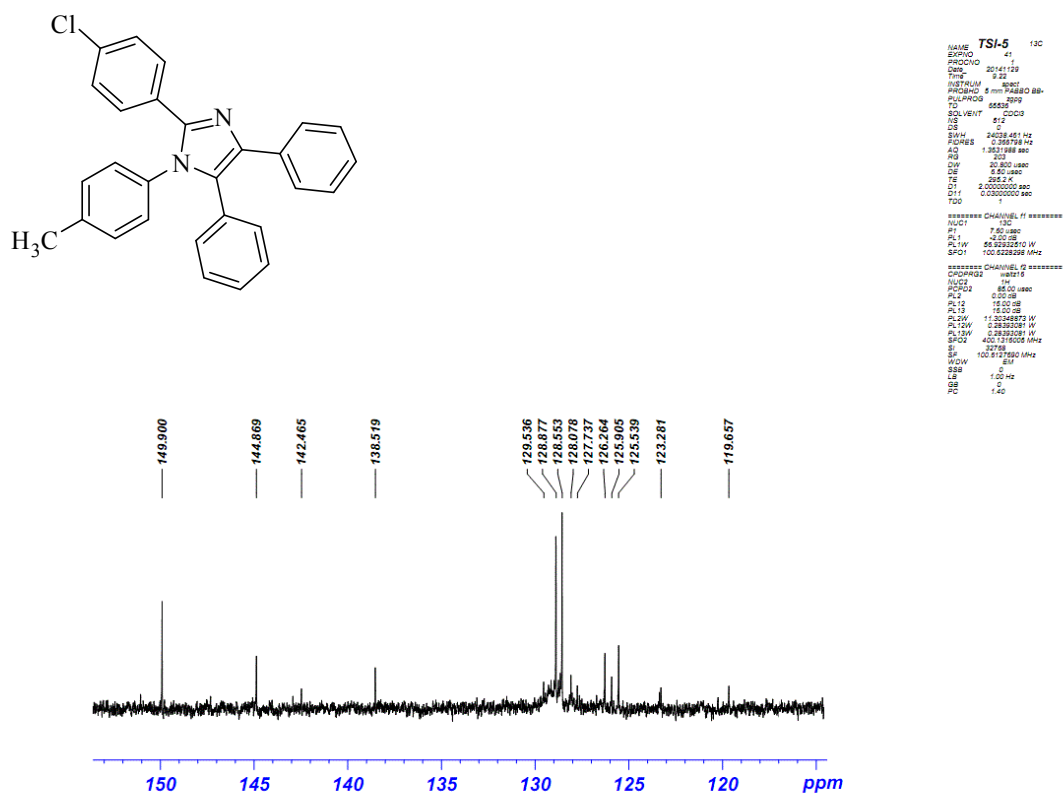


Fig. S33. The IR spectrum of 1,2-bis(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 5)

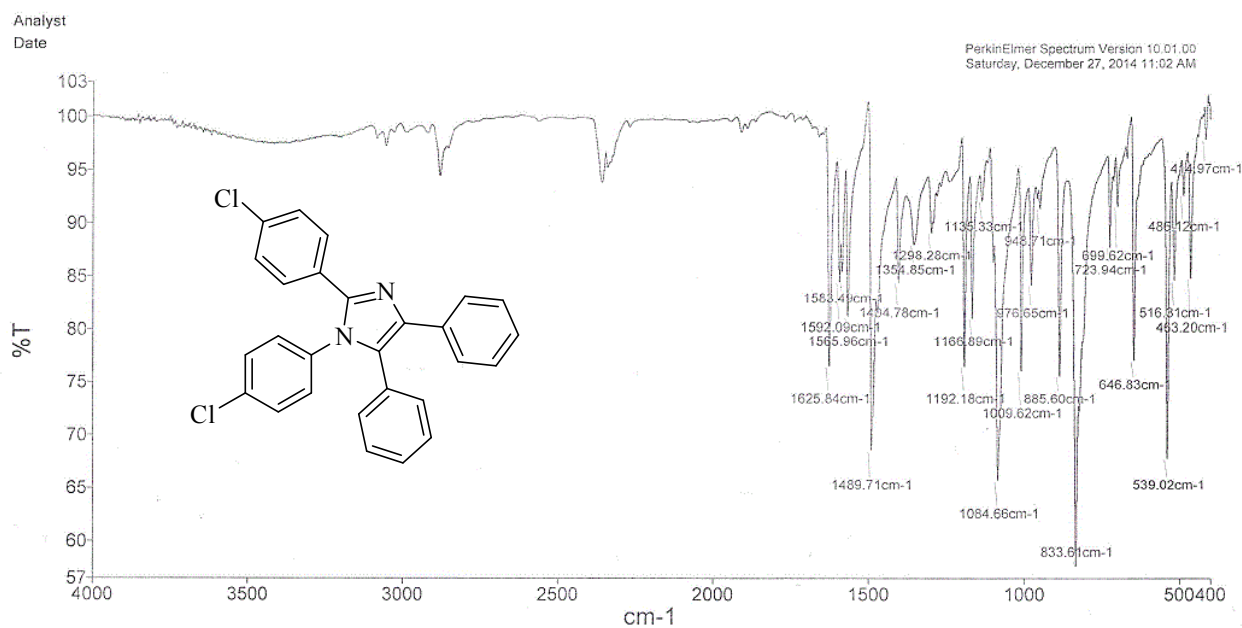


Fig. S34. The <sup>1</sup>H NMR spectrum of 1,2-bis(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 5)

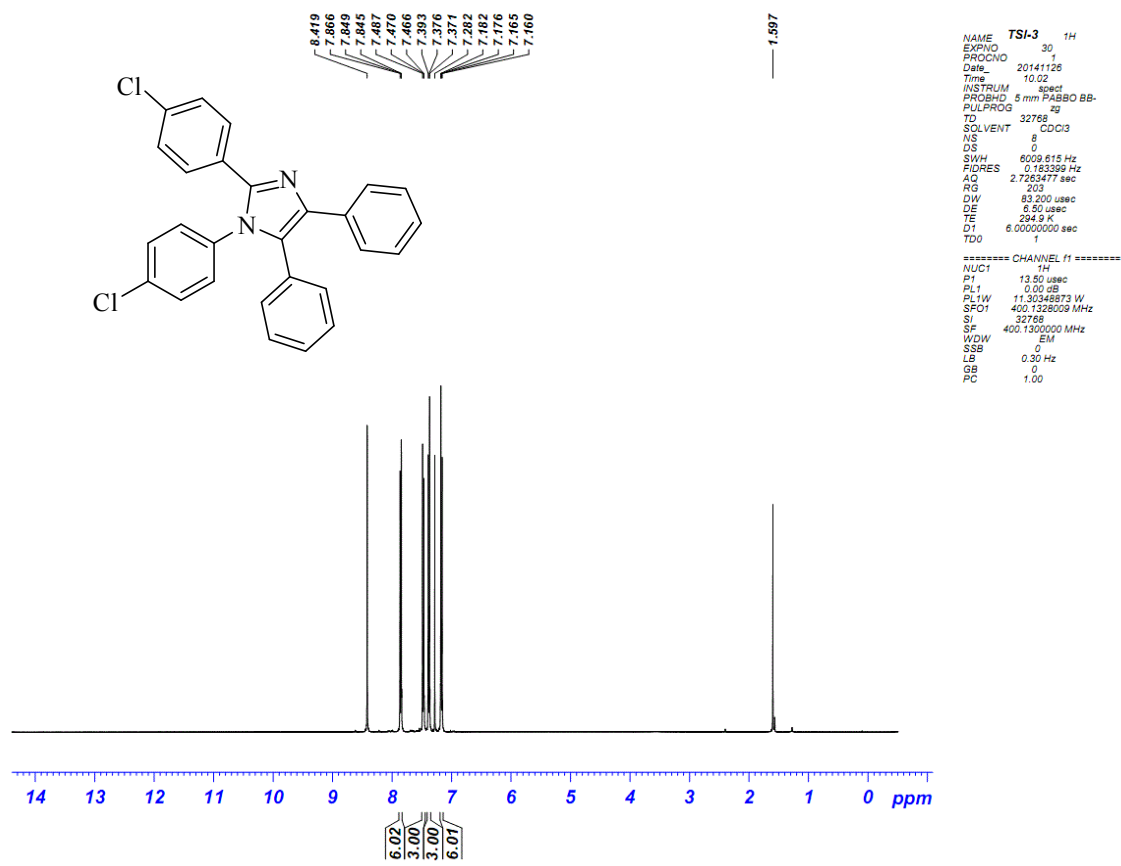


Fig. S35. The <sup>1</sup>H NMR spectrum of 1,2-bis(4-chlorophenyl)-4,5-diphenyl-1H-imidazole (Table 4, entry 5)

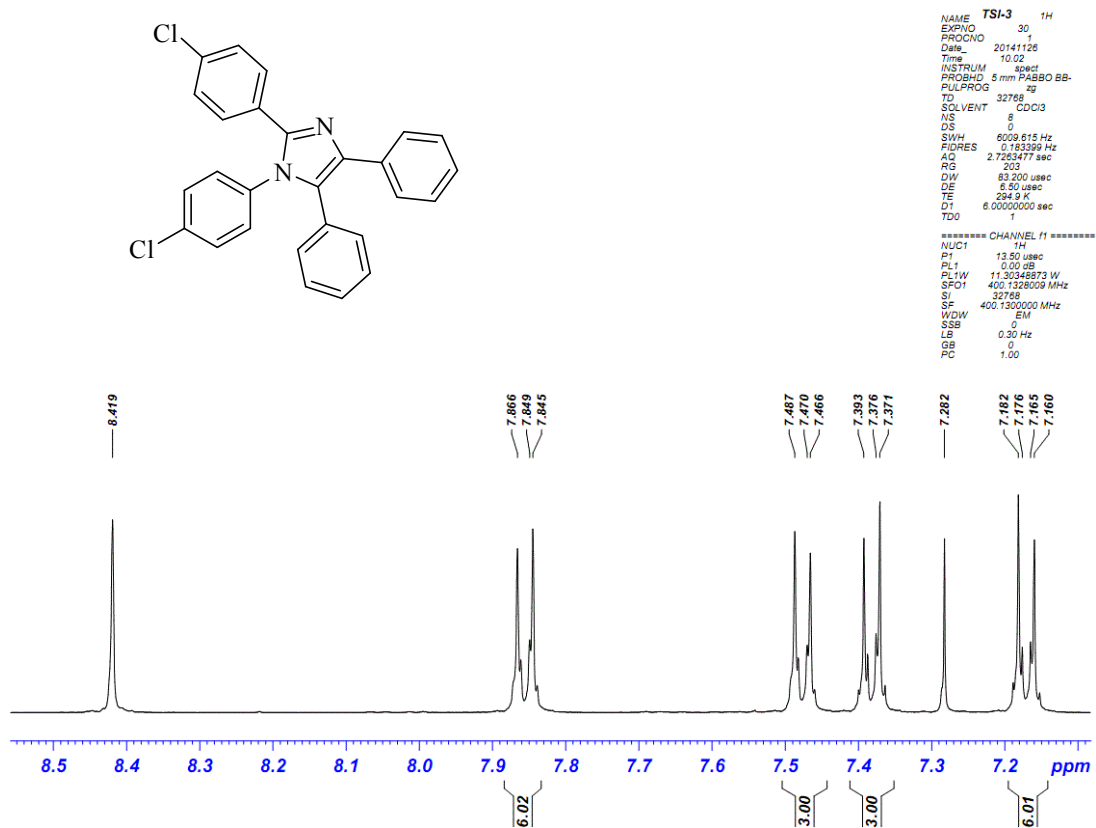
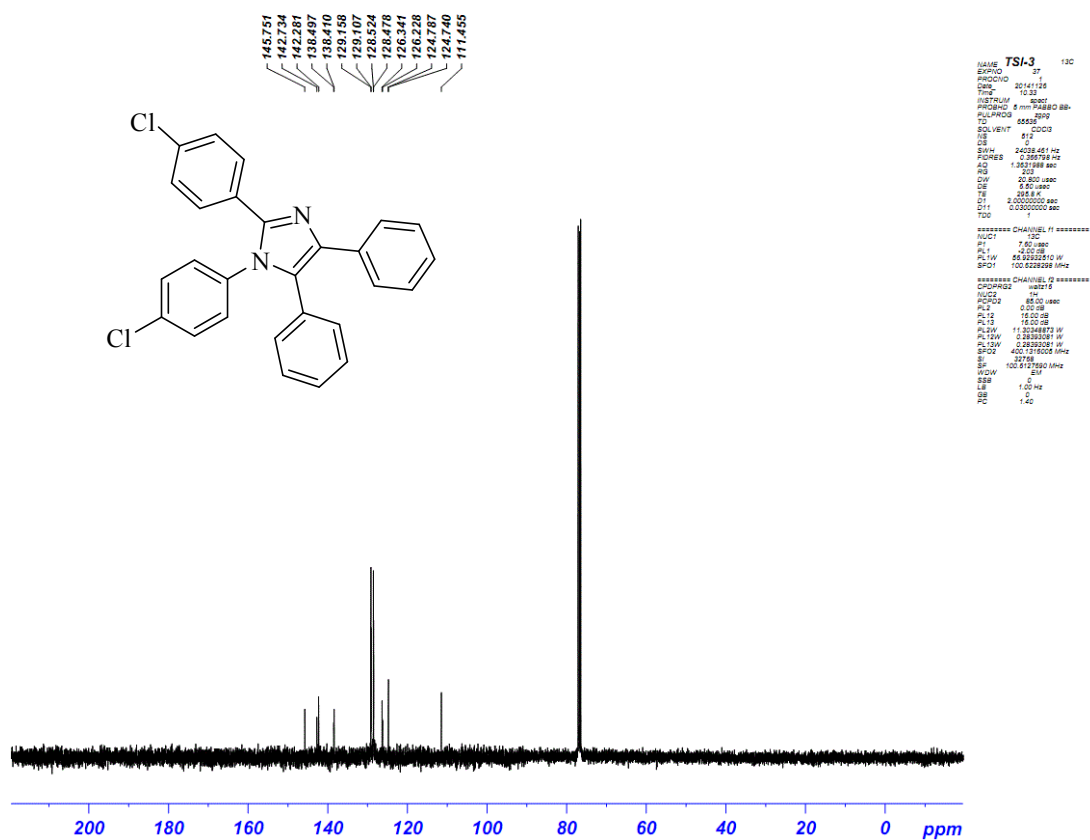


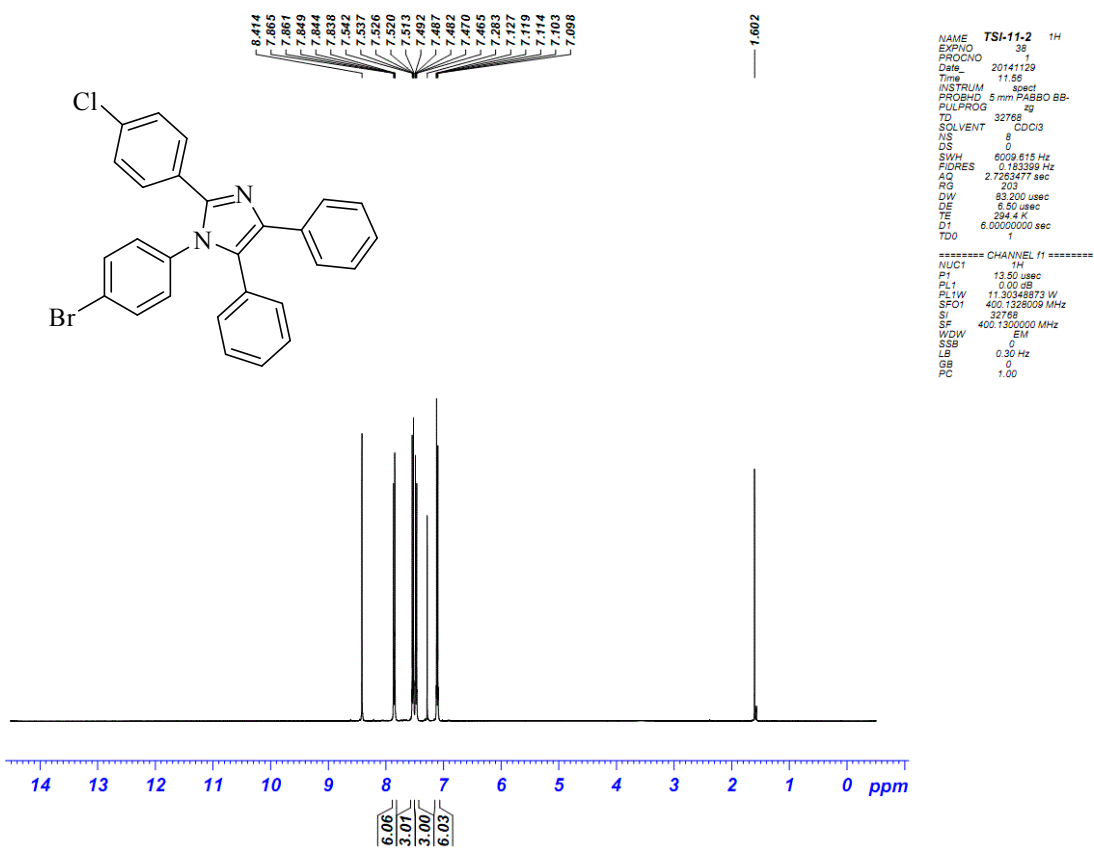


Fig. S36. The <sup>13</sup>C NMR spectrum of 1,2-bis(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 5)

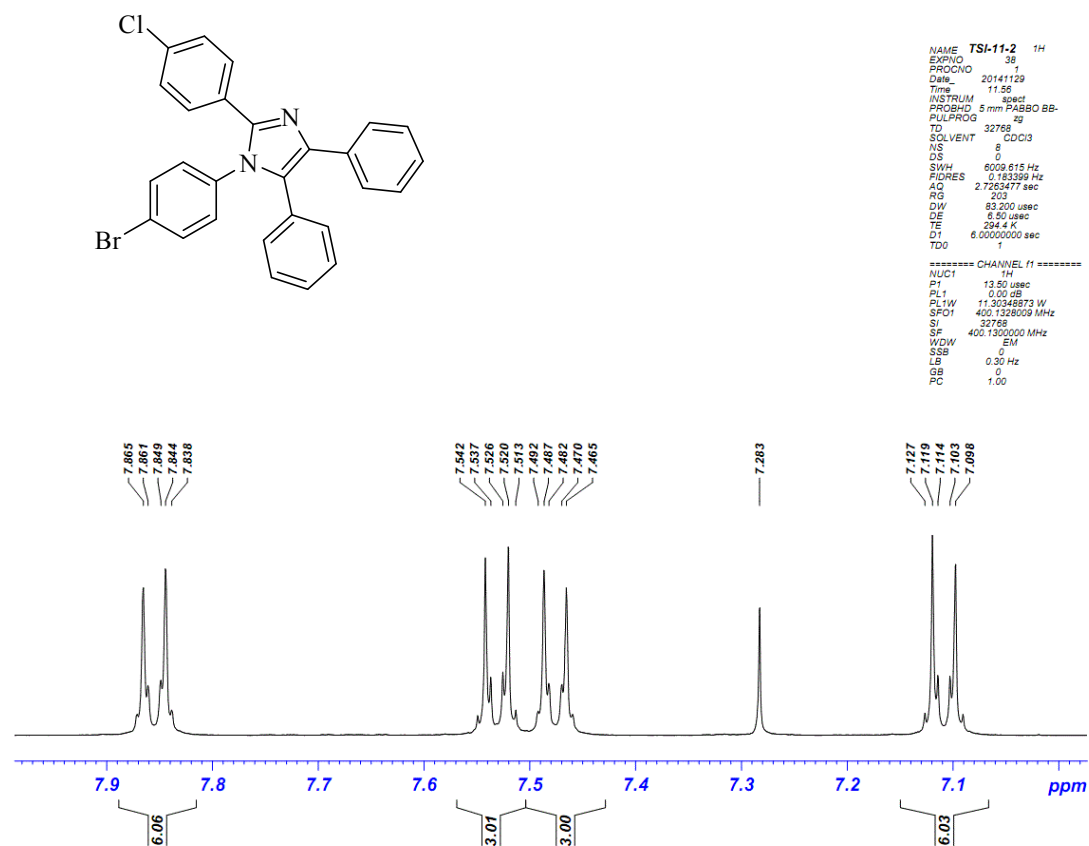




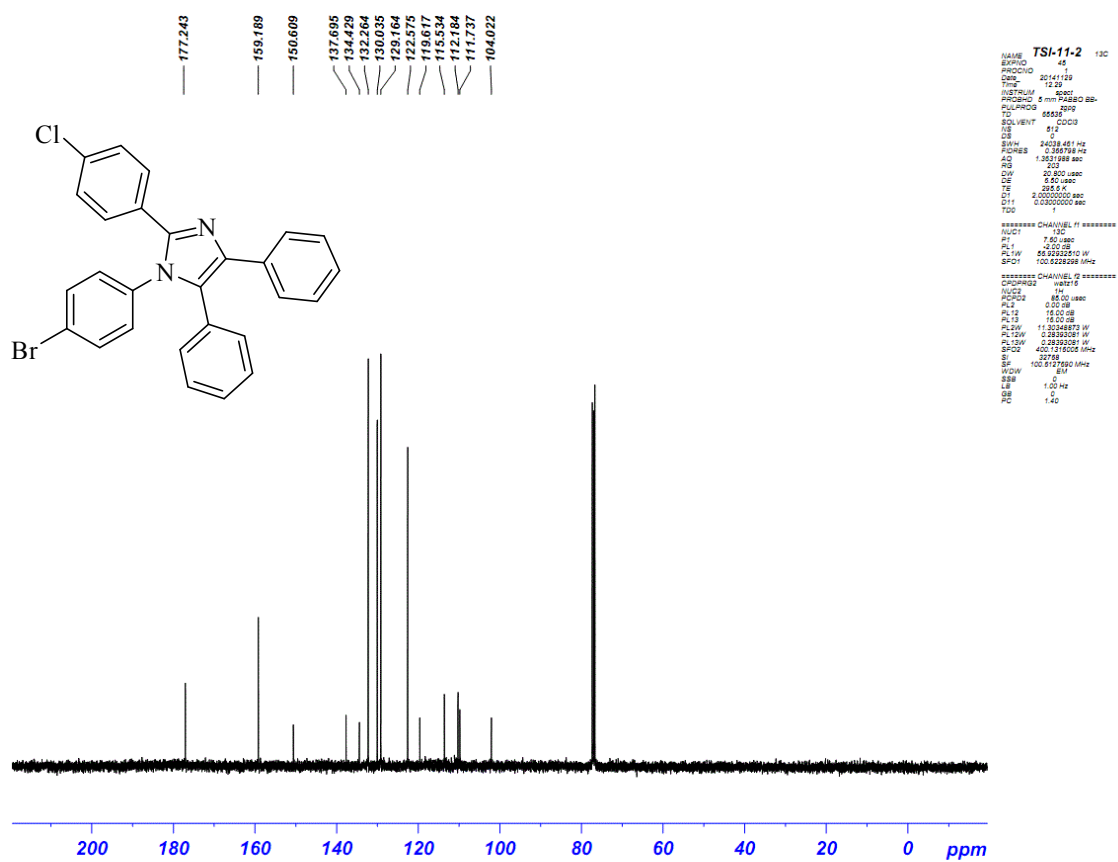
**Fig. S39.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 6)



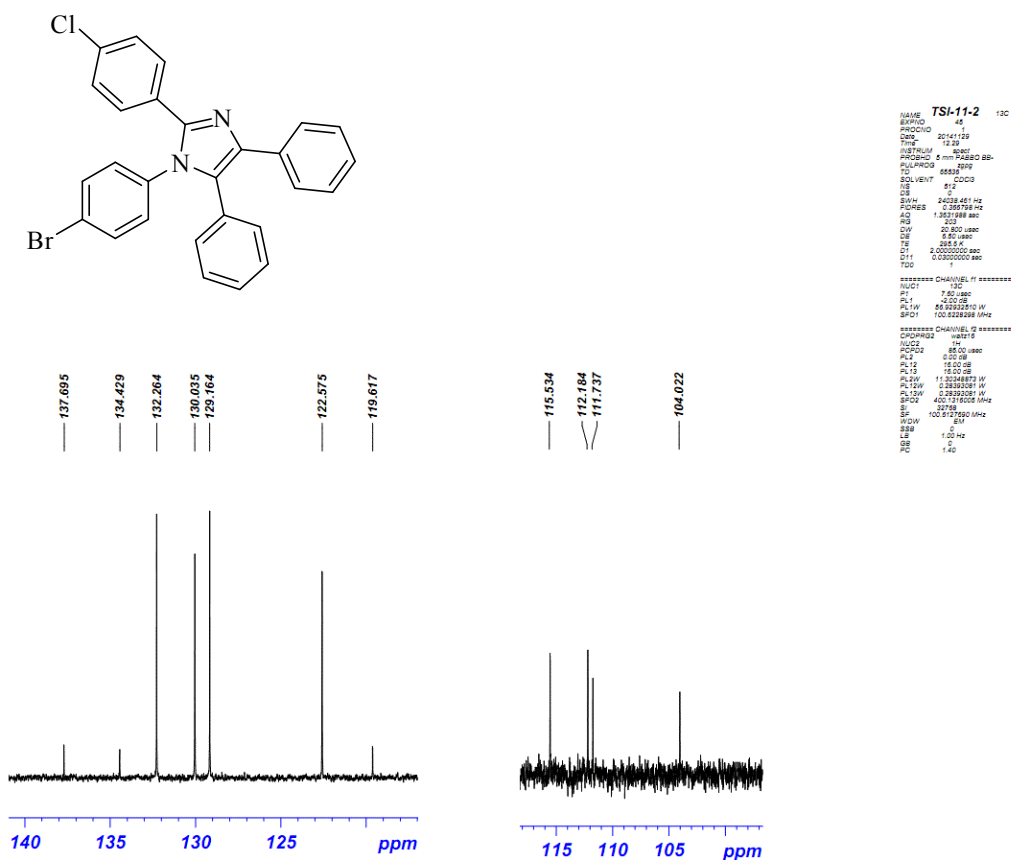
**Fig. S40.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 6)



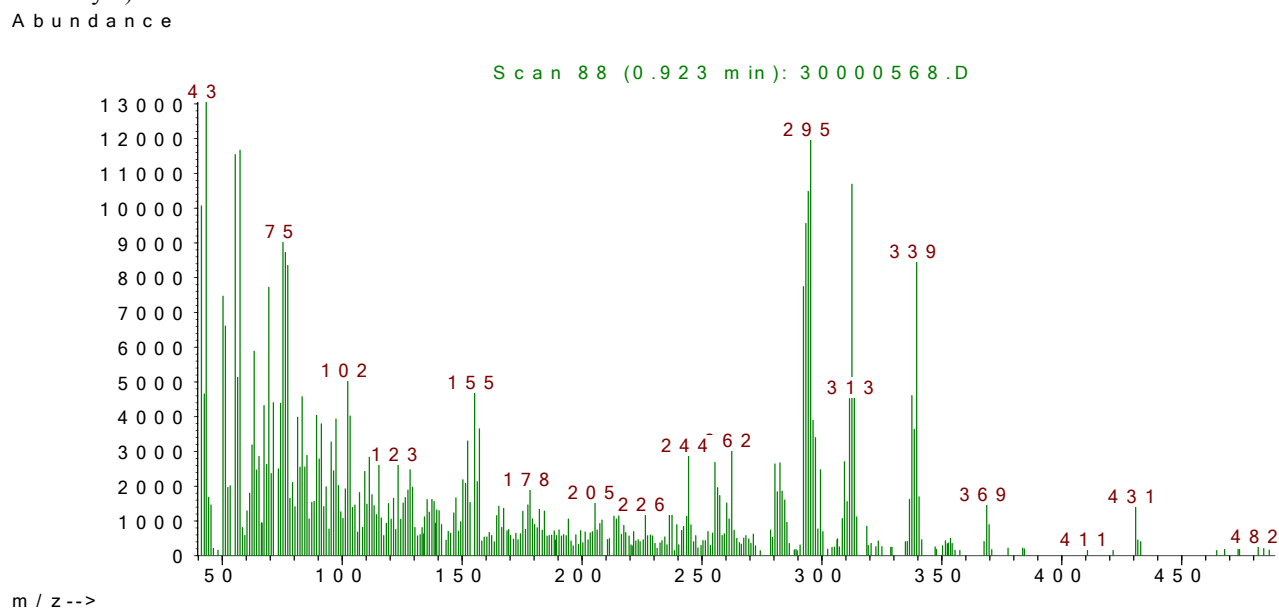
**Fig. S41.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 6)



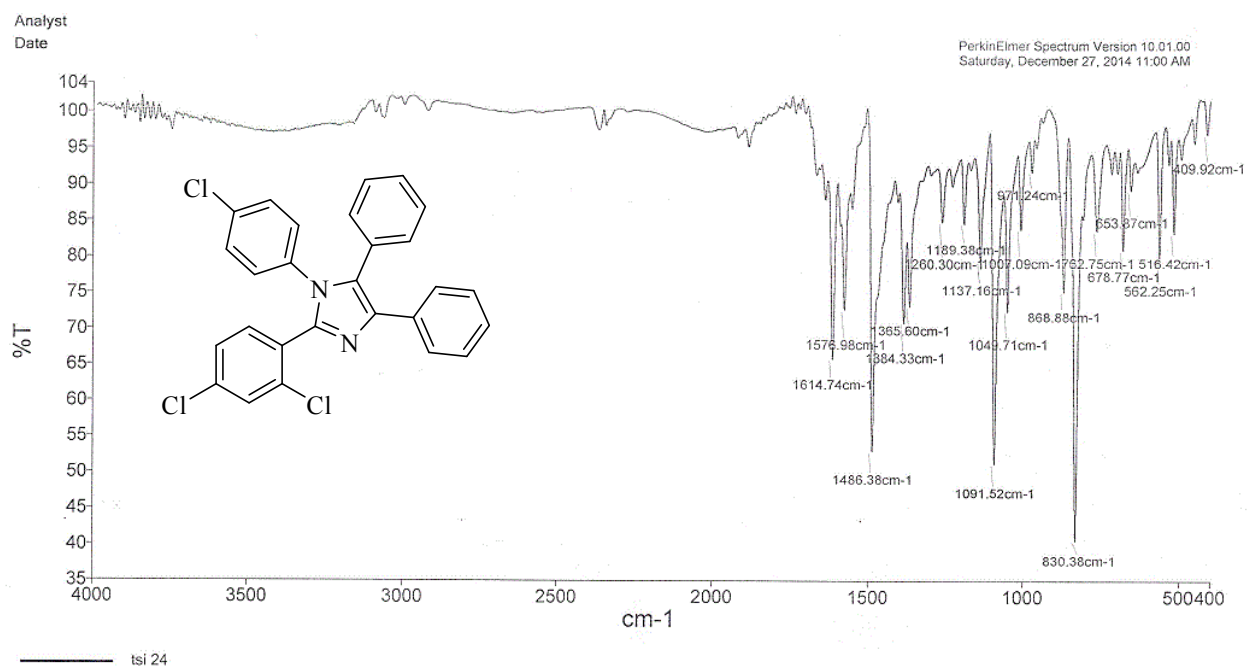
**Fig. S42.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 6)



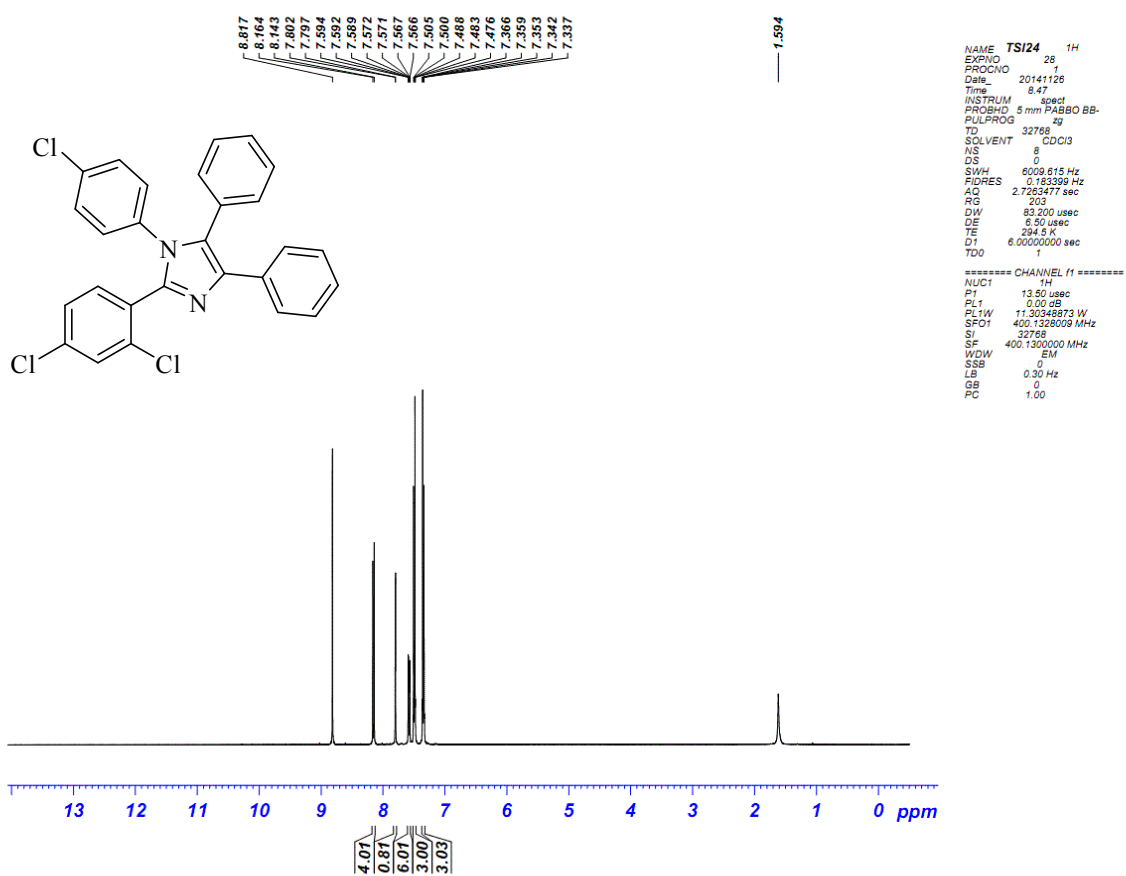
**Fig. S43.** The mass spectrum of 1-(4-bromophenyl)-2-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 6)



**Fig. S44.** The IR spectrum of 1-(4-chlorophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 7)

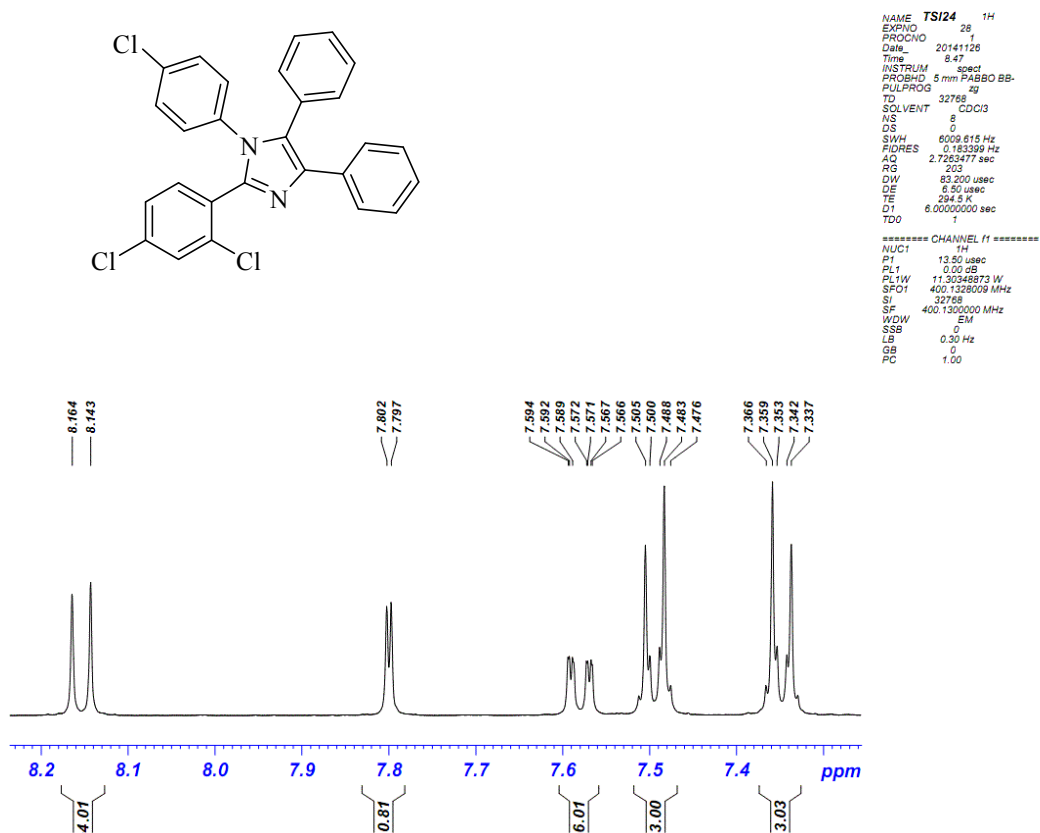


**Fig. S45.** The  $^1\text{H}$  NMR spectrum of 1-(4-chlorophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 7)

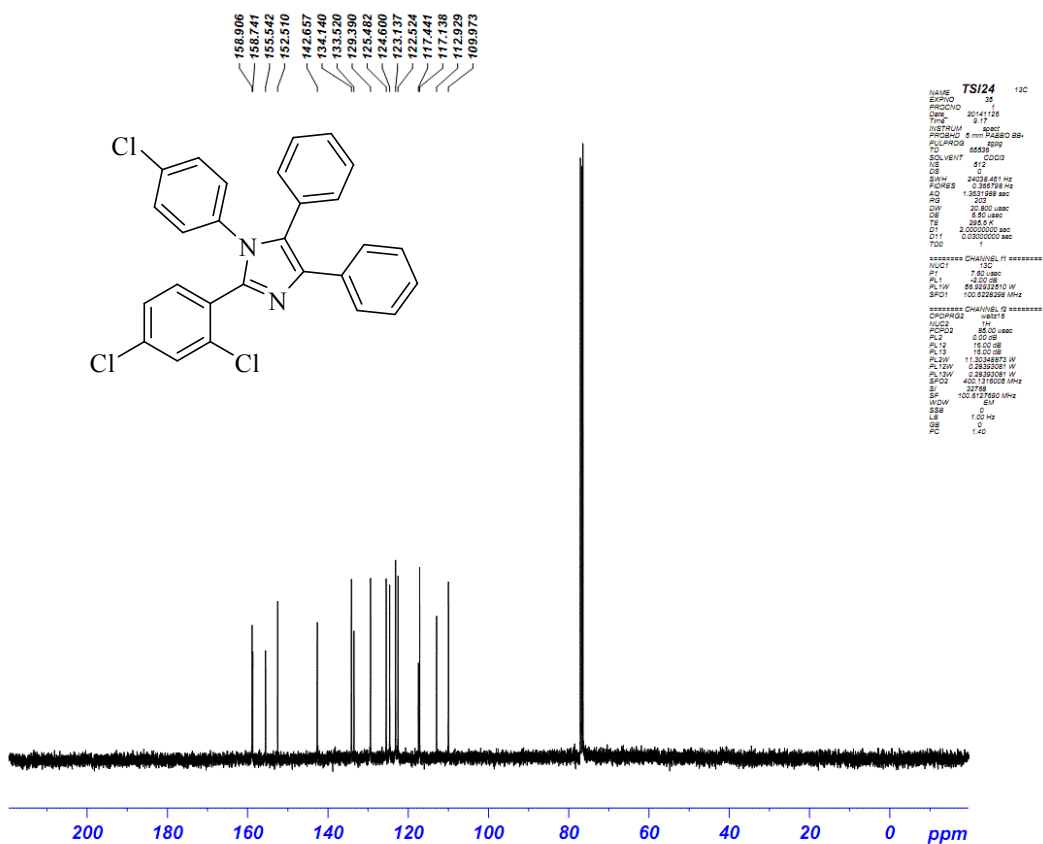




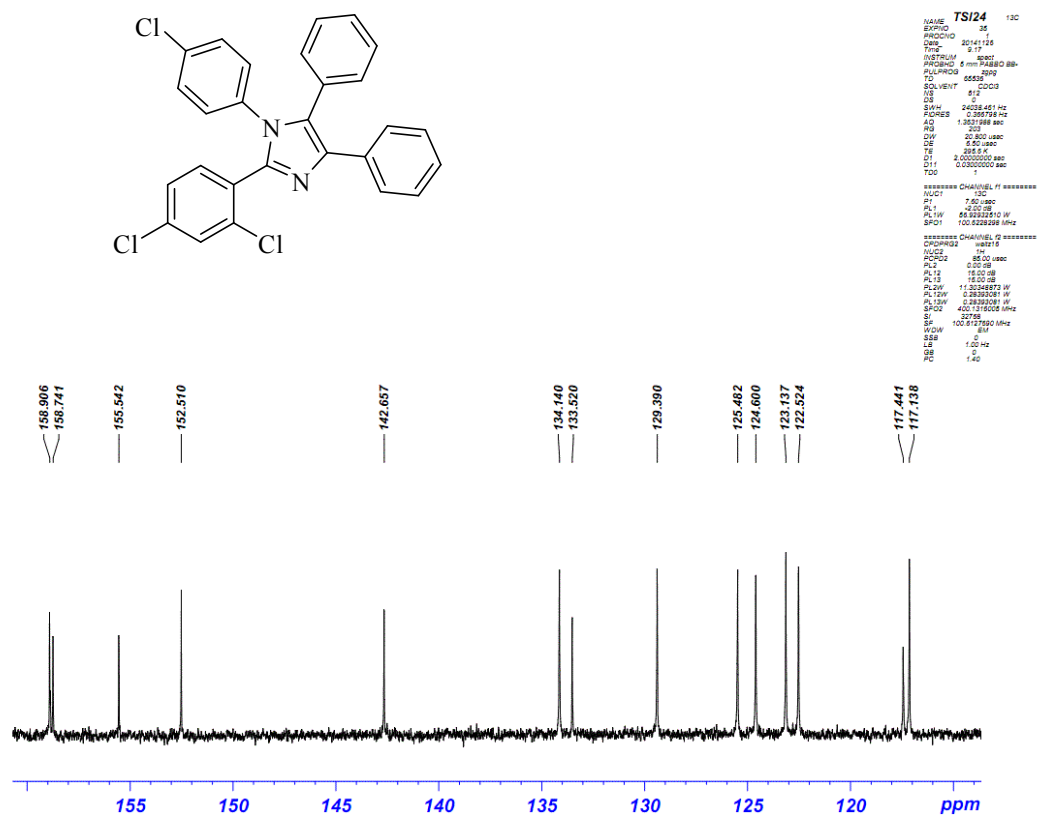
**Fig. S46.** The  $^1\text{H}$  NMR spectrum of 1-(4-chlorophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 7)



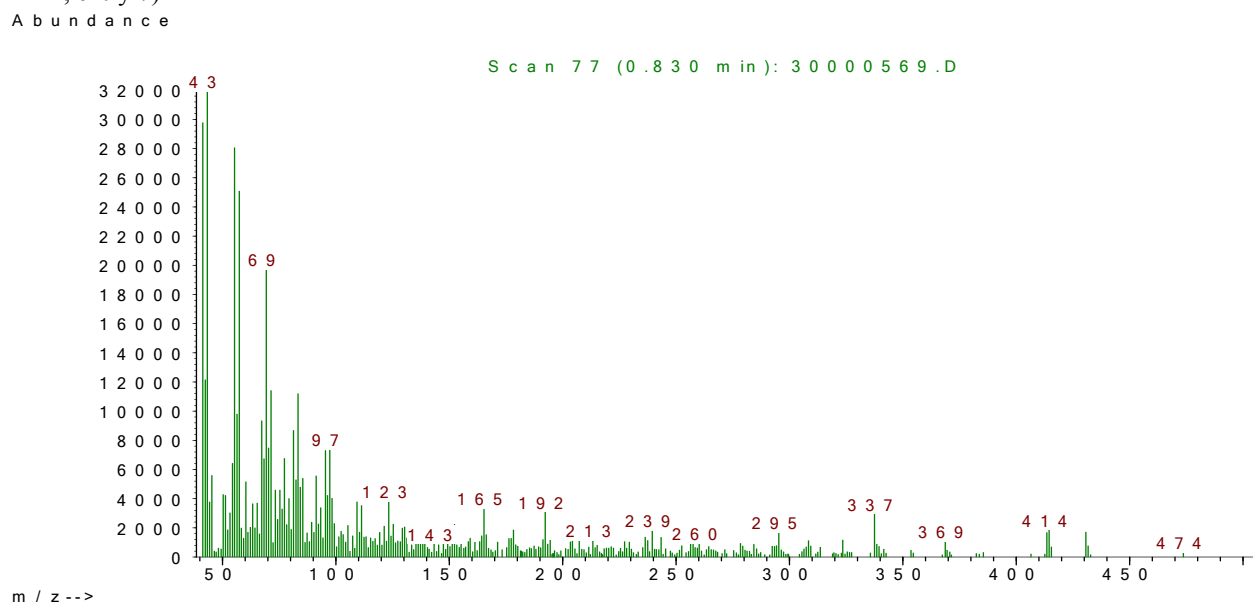
**Fig. S47.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-chlorophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 7)



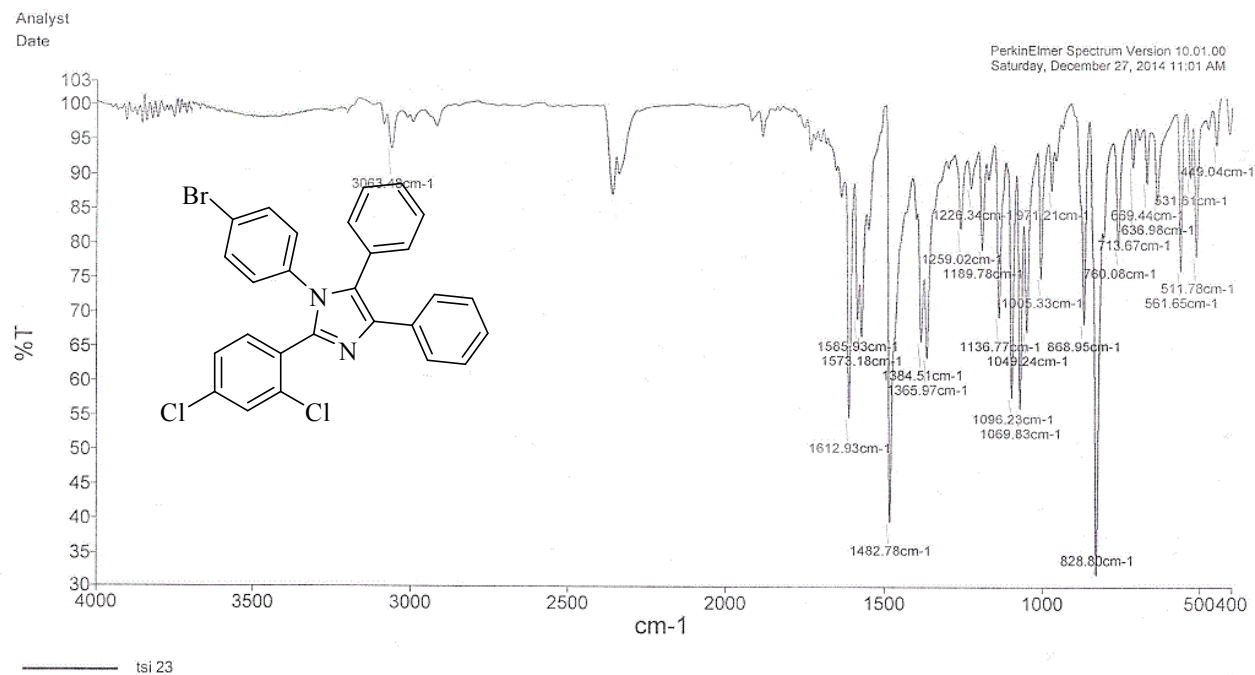
**Fig. S48.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-chlorophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 7)



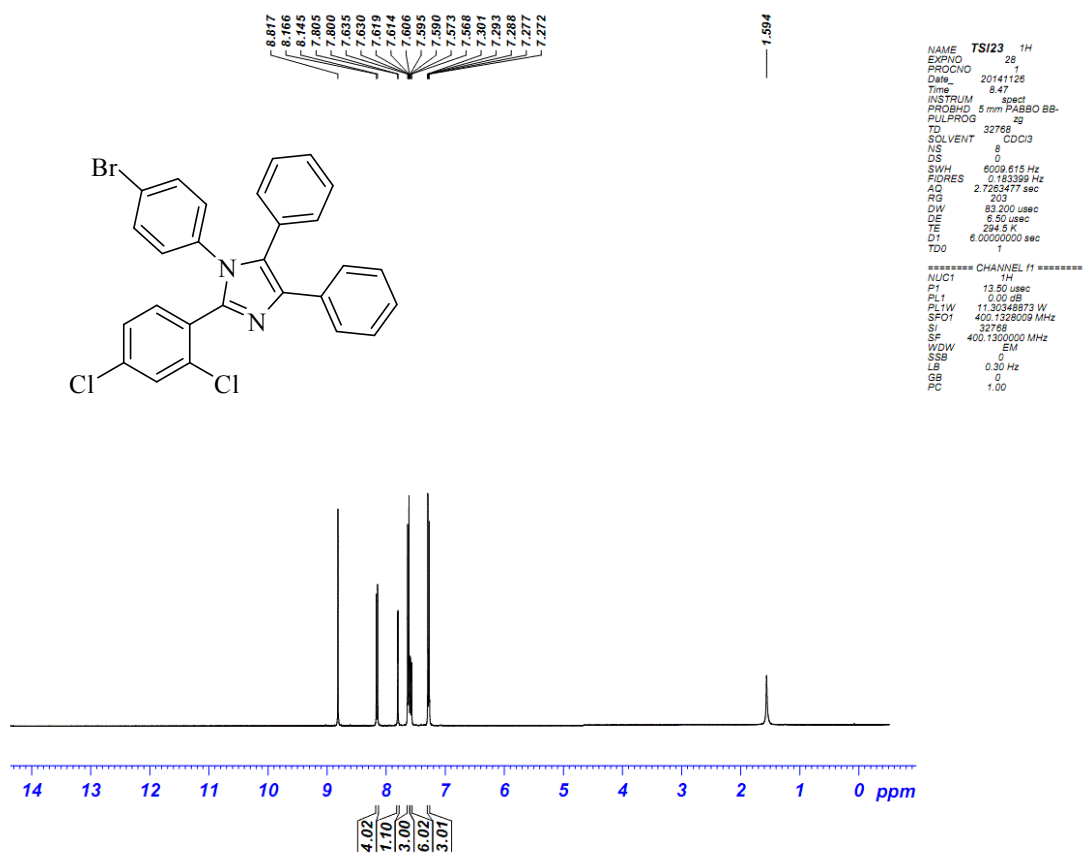
**Fig. S49.** The mass spectrum of 1-(4-chlorophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 7)



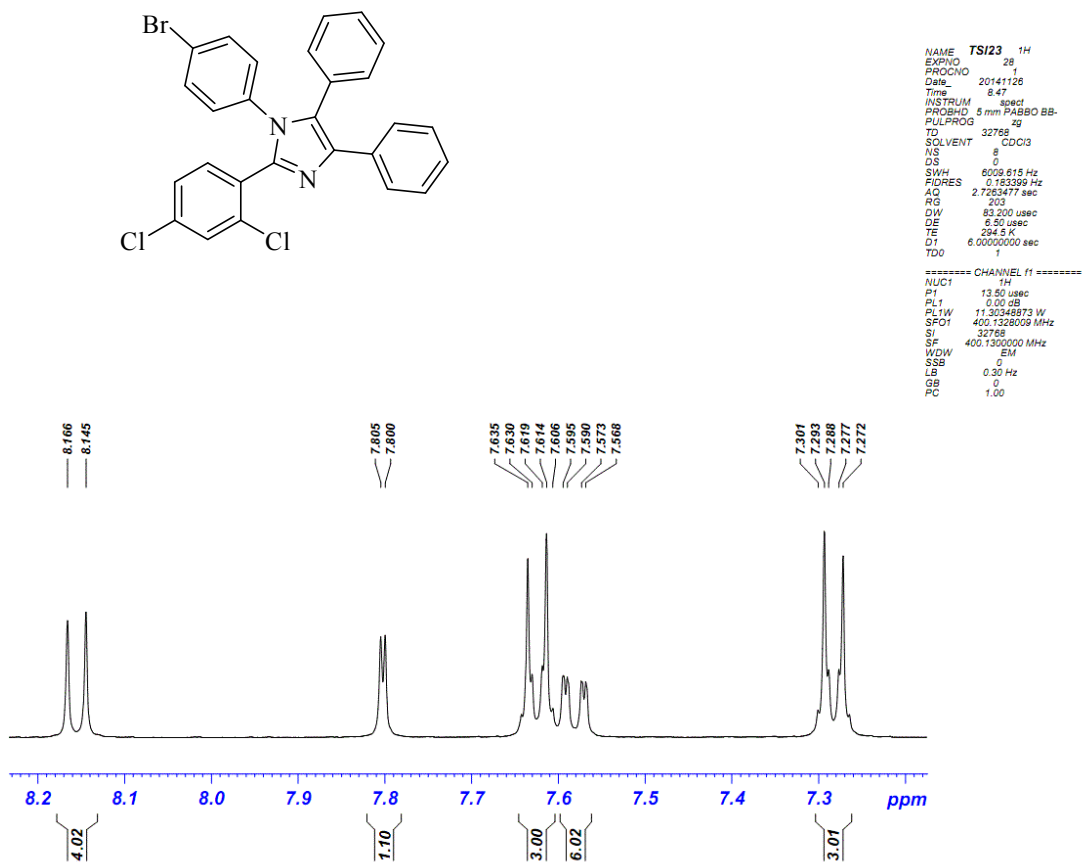
**Fig. S50.** The IR spectrum of 1-(4-bromophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 8)



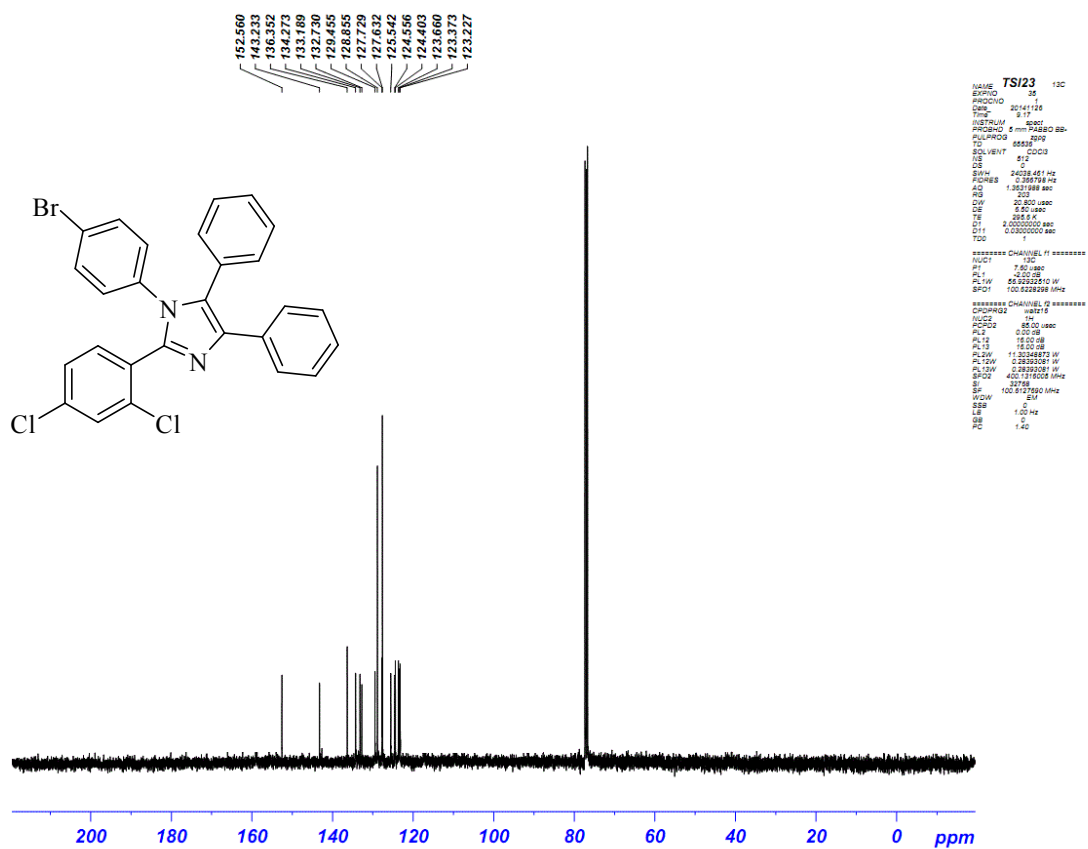
**Fig. S51.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 8)



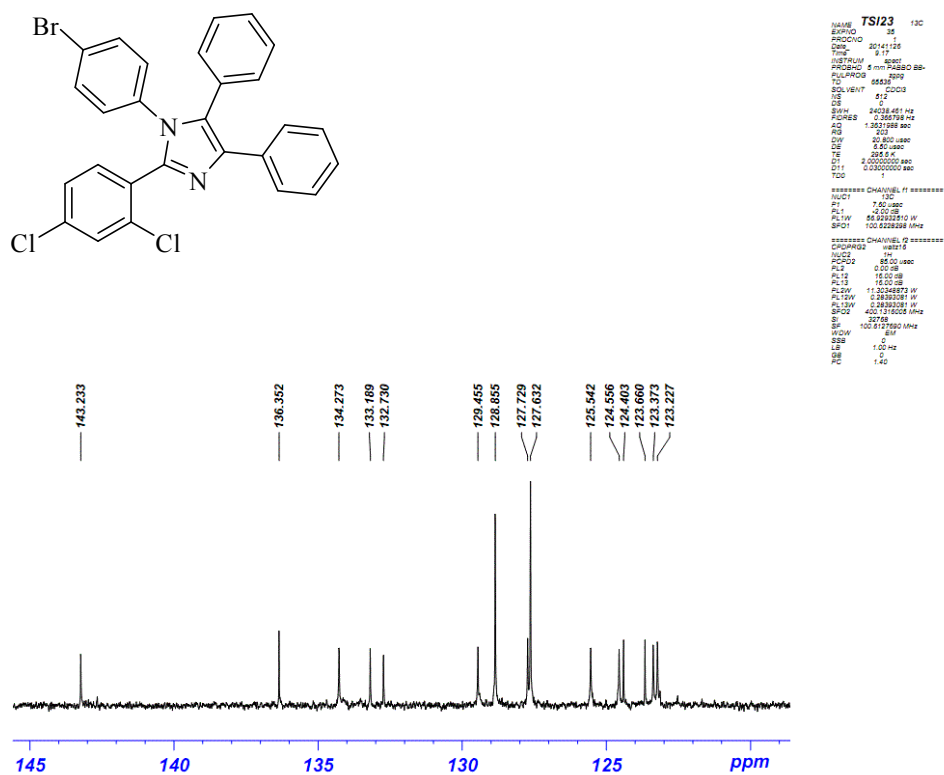
**Fig. S52.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 8)



**Fig. S53.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 8)



**Fig. S54.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 8)



**Fig. S55.** The mass spectrum of 1-(4-bromophenyl)-2-(2,4-dichlorophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 8)

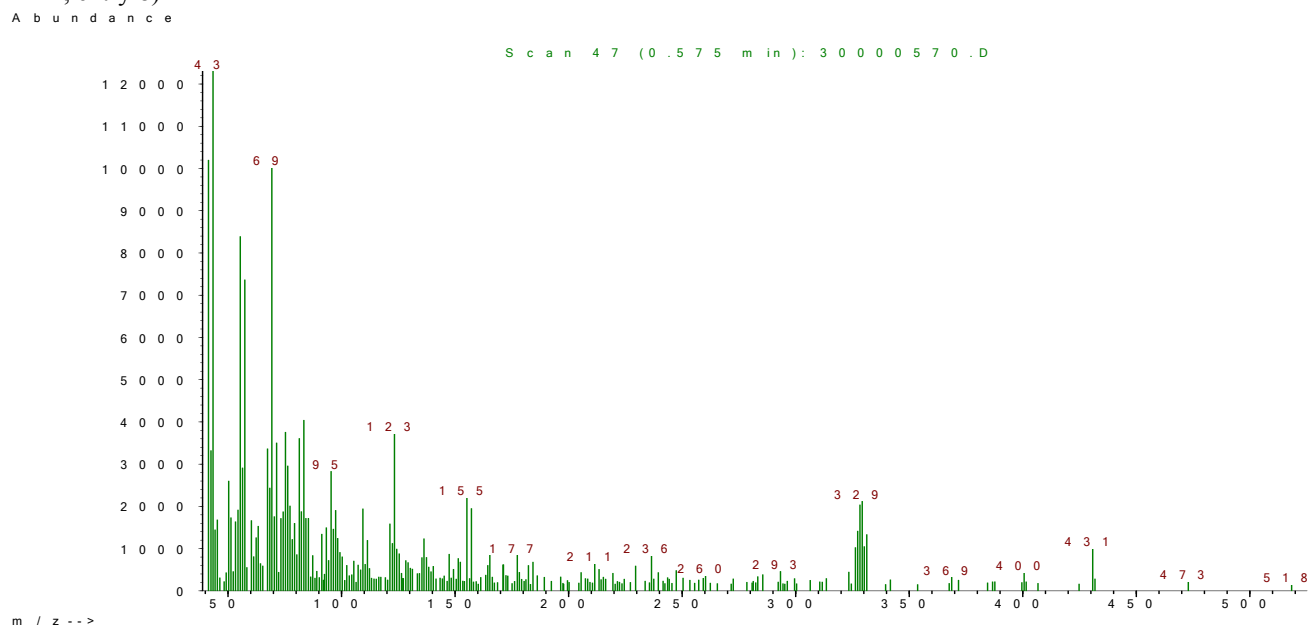




Fig. S56. The IR spectrum of 1-(4-chlorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 9)

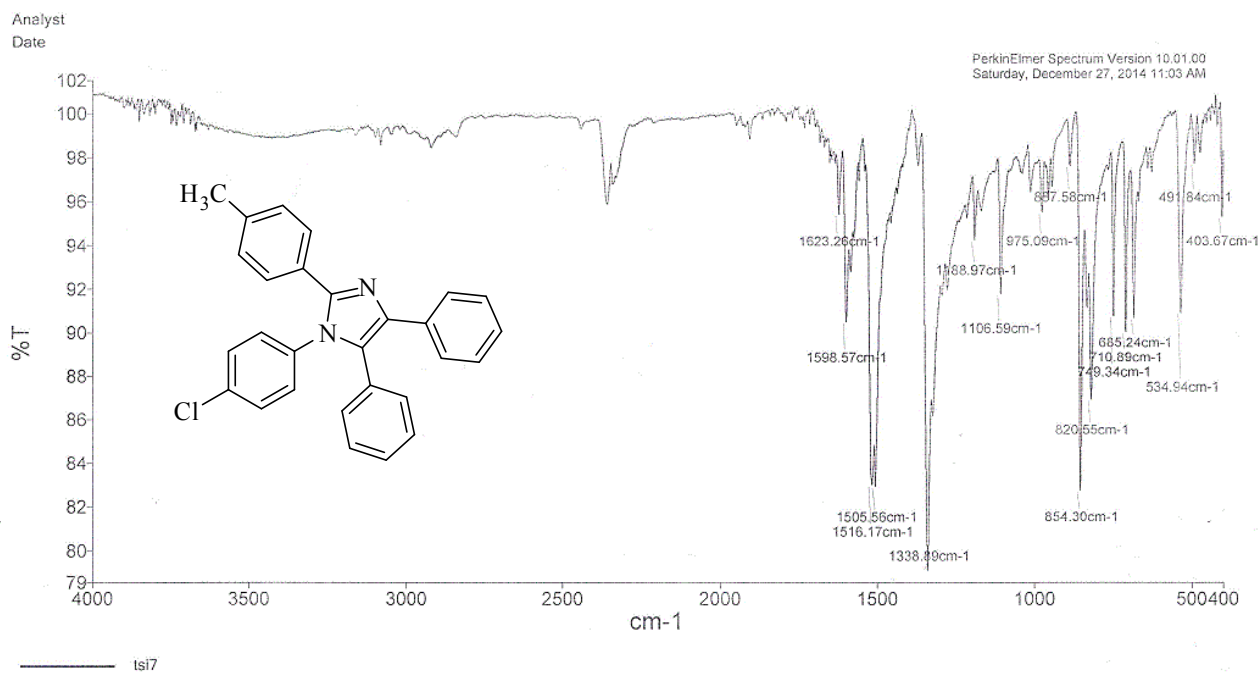


Fig. S57. The <sup>1</sup>H NMR spectrum of 1-(4-chlorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 9)

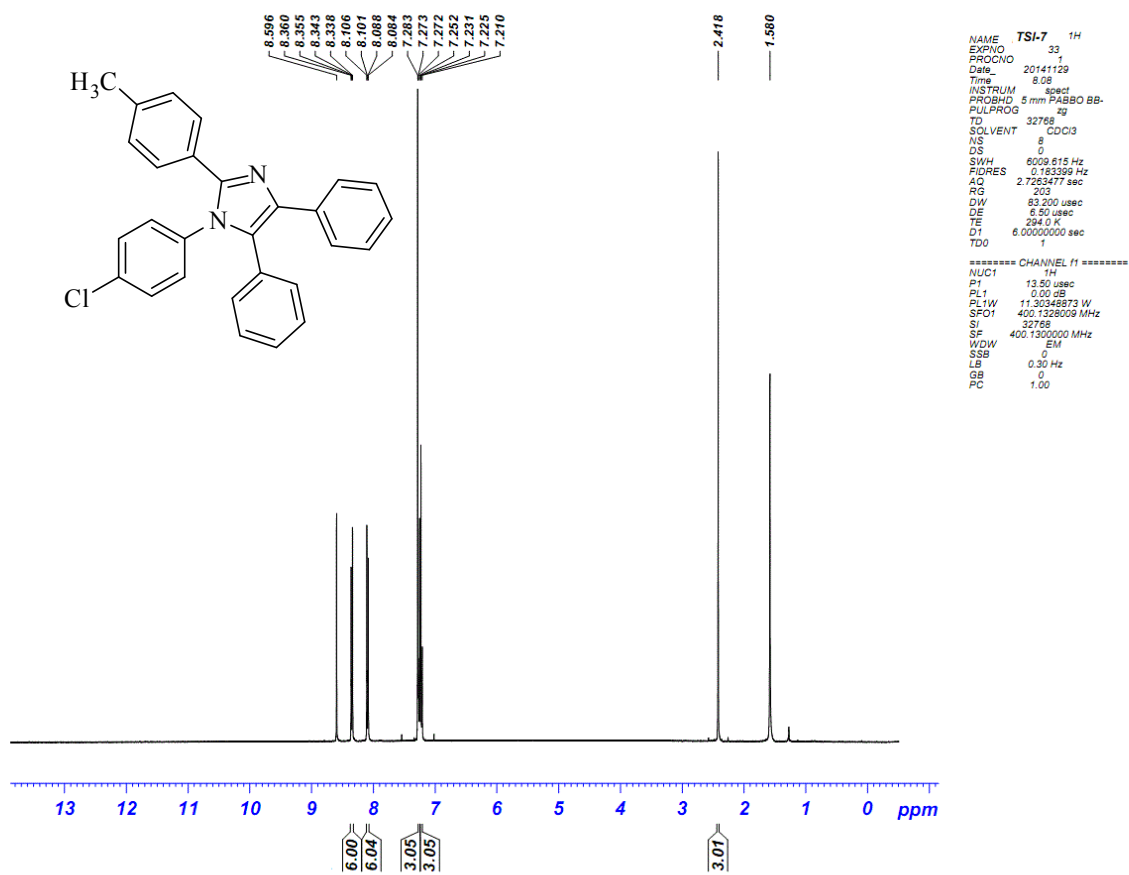
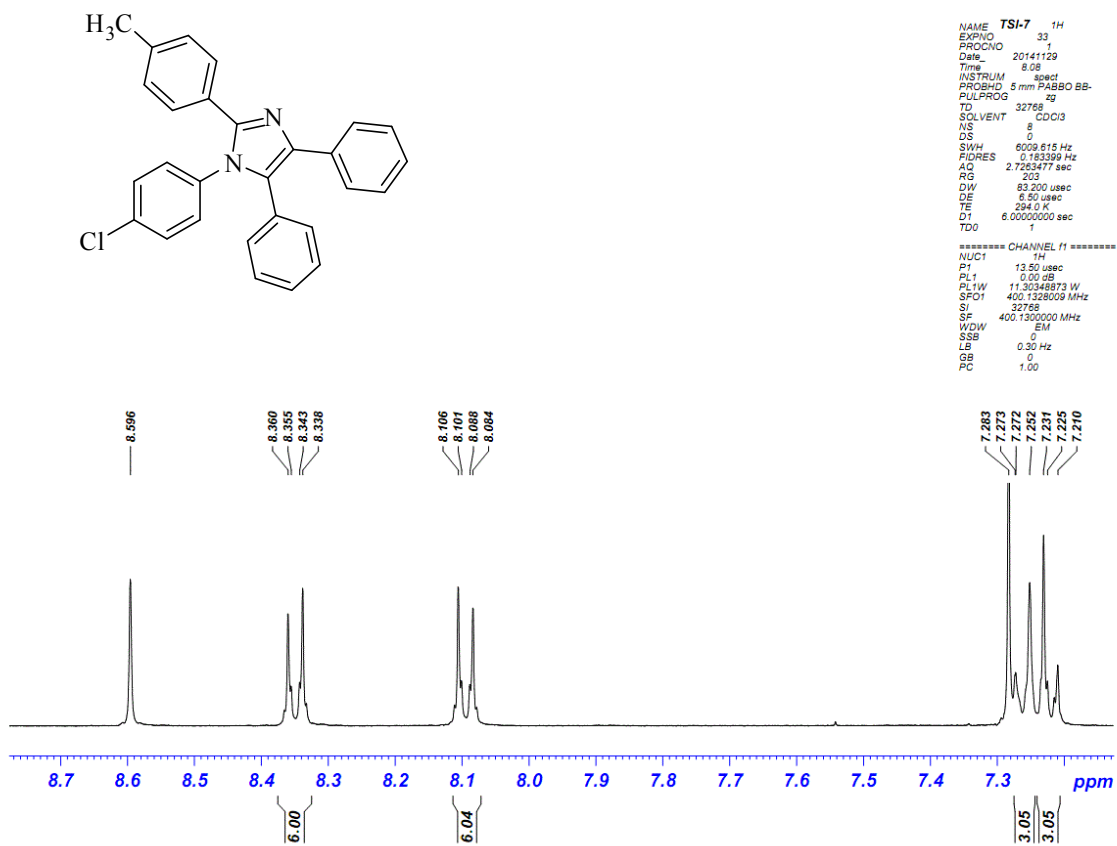


Fig. S58. The <sup>1</sup>H NMR spectrum of 1-(4-chlorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 9)



**Fig. S59.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-chlorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 9)

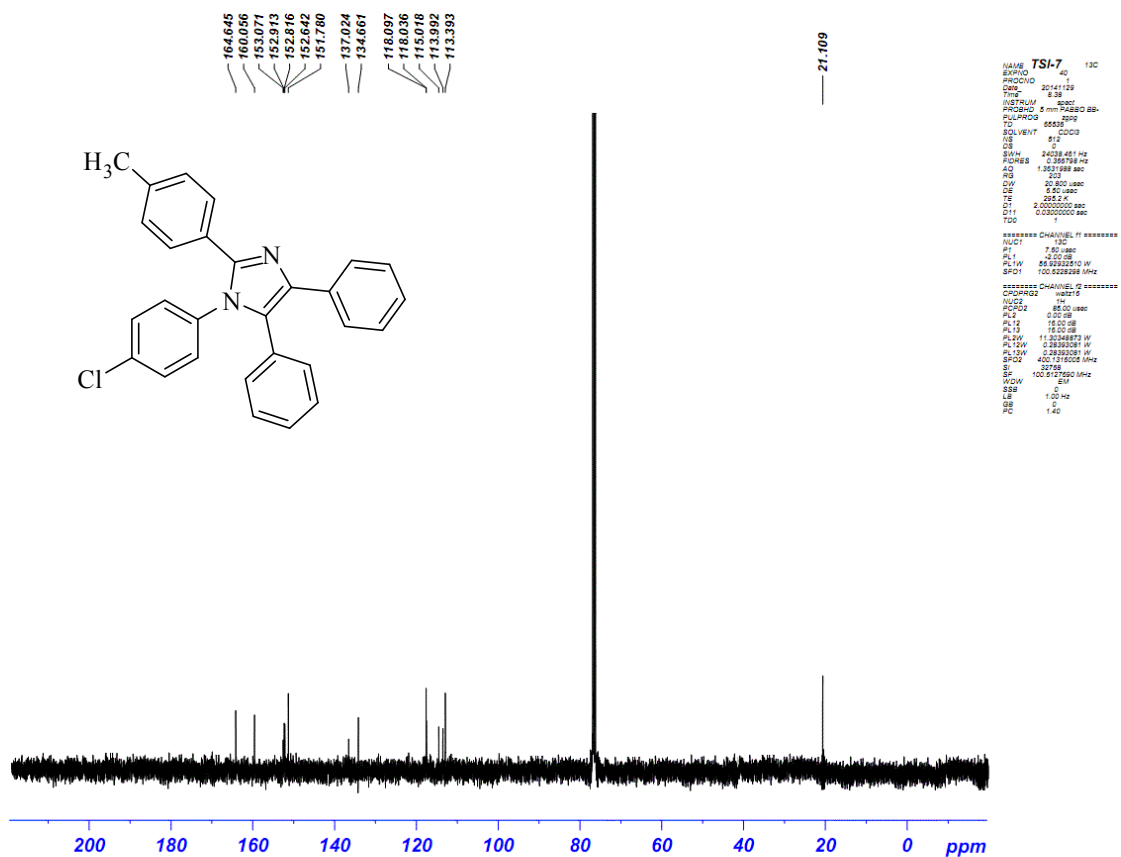


Fig. S60. The  $^{13}\text{C}$  NMR spectrum of 1-(4-chlorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 9)

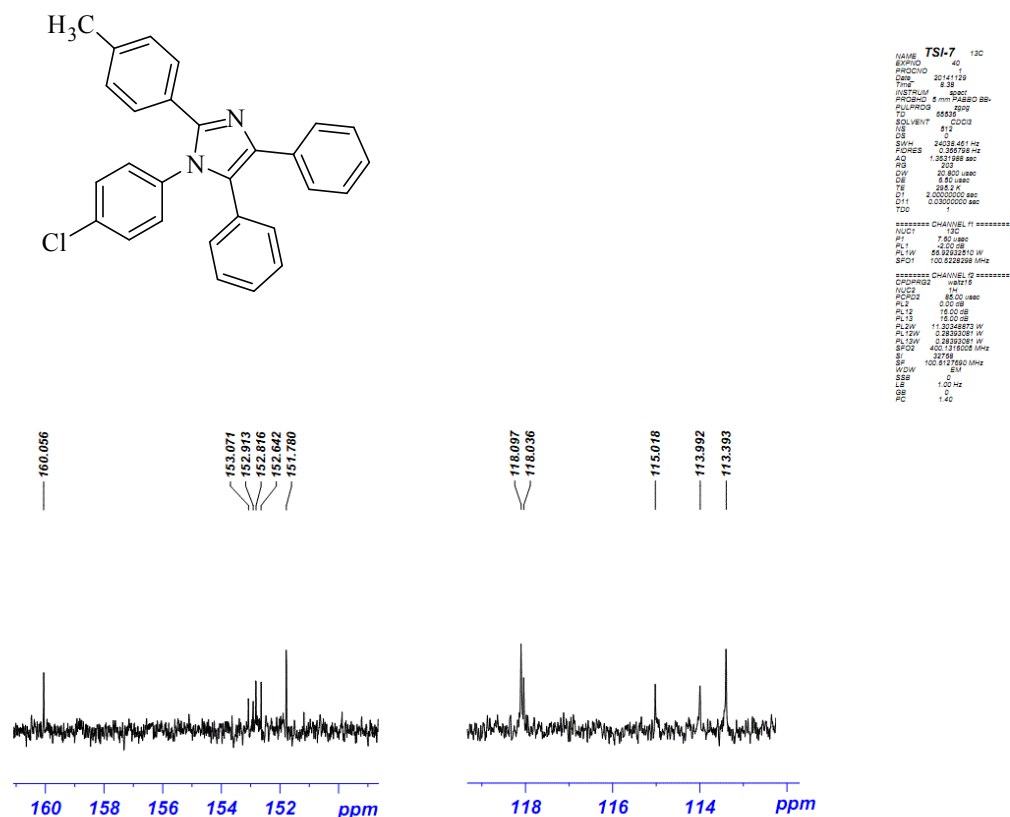


Fig. S61. The IR spectrum of 1-(4-bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 10)

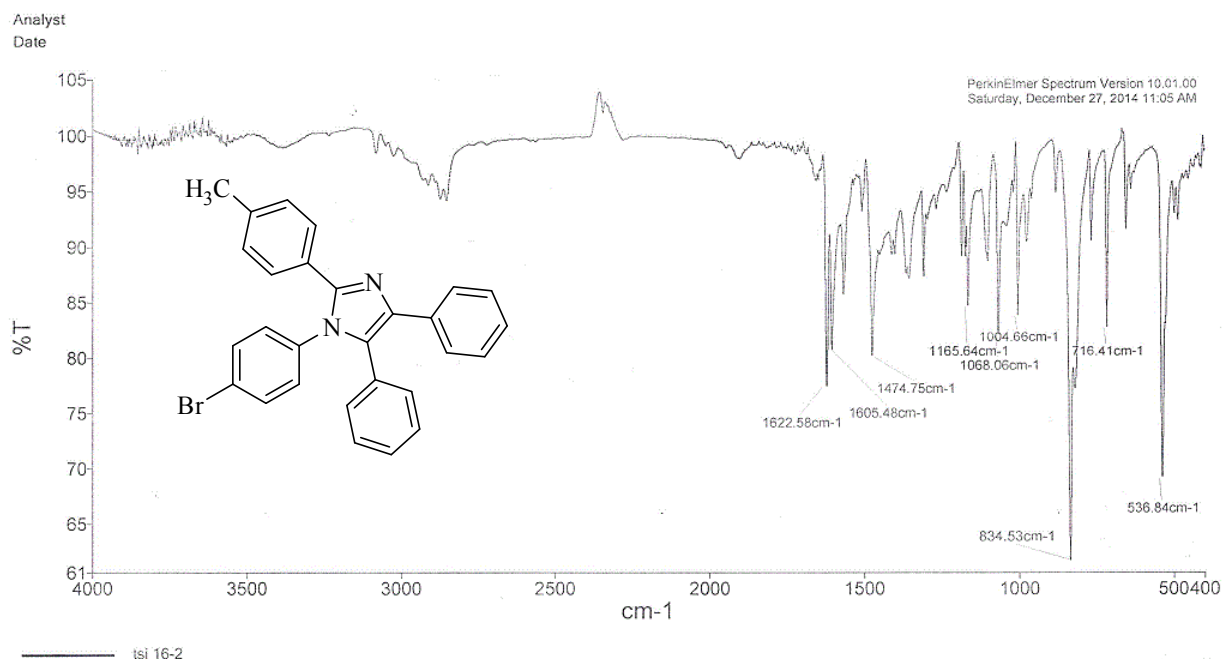


Fig. S62. The <sup>1</sup>H NMR spectrum of 1-(4-bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 10)

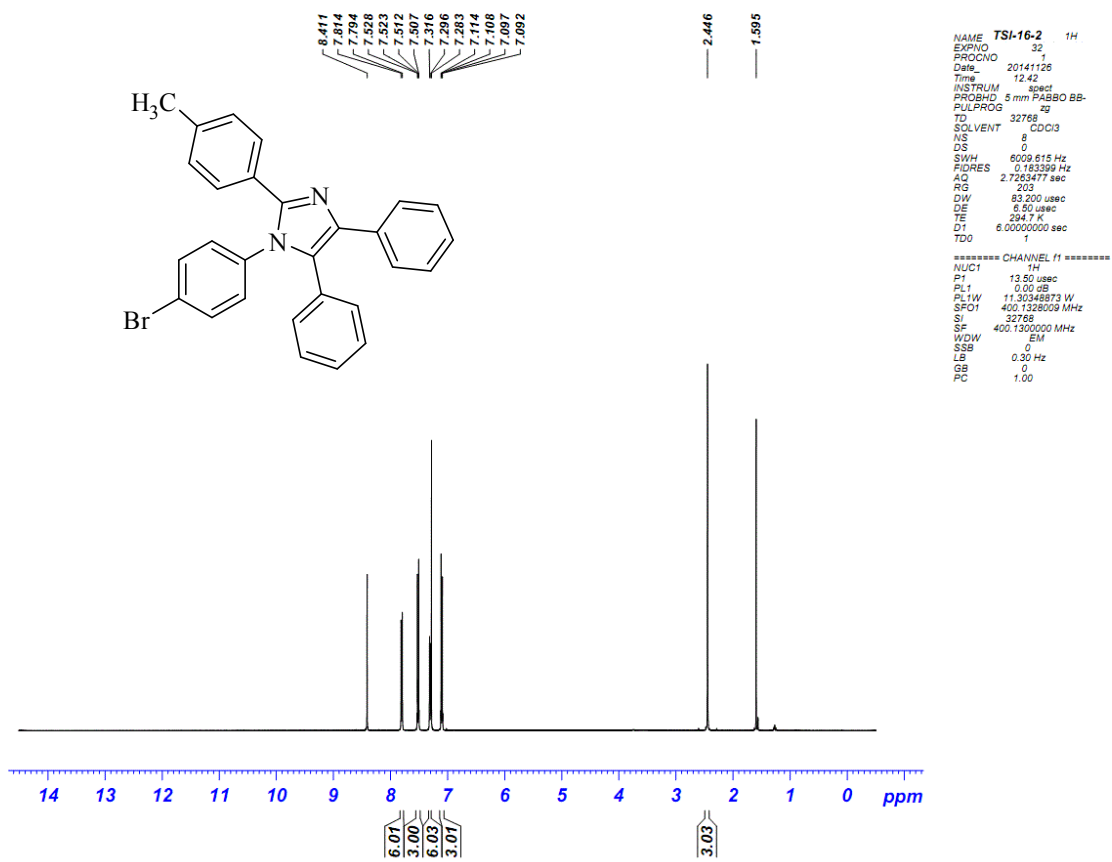
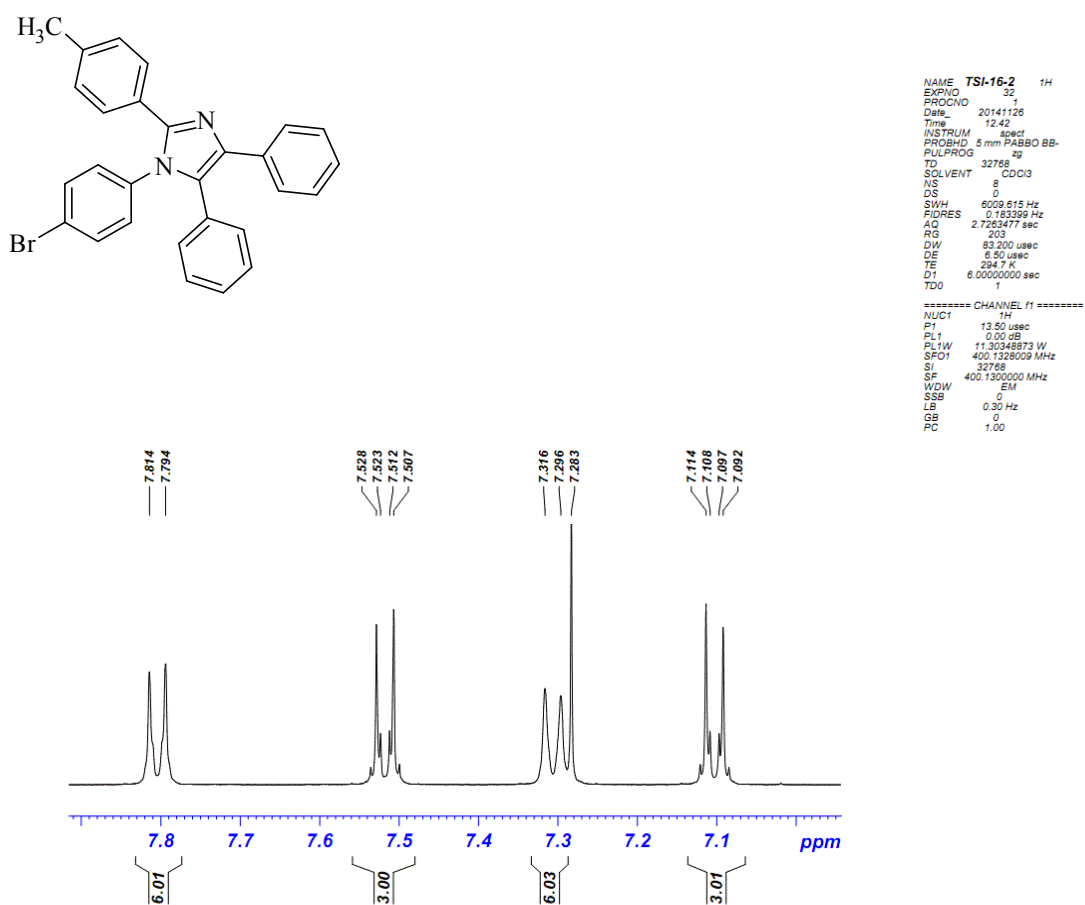
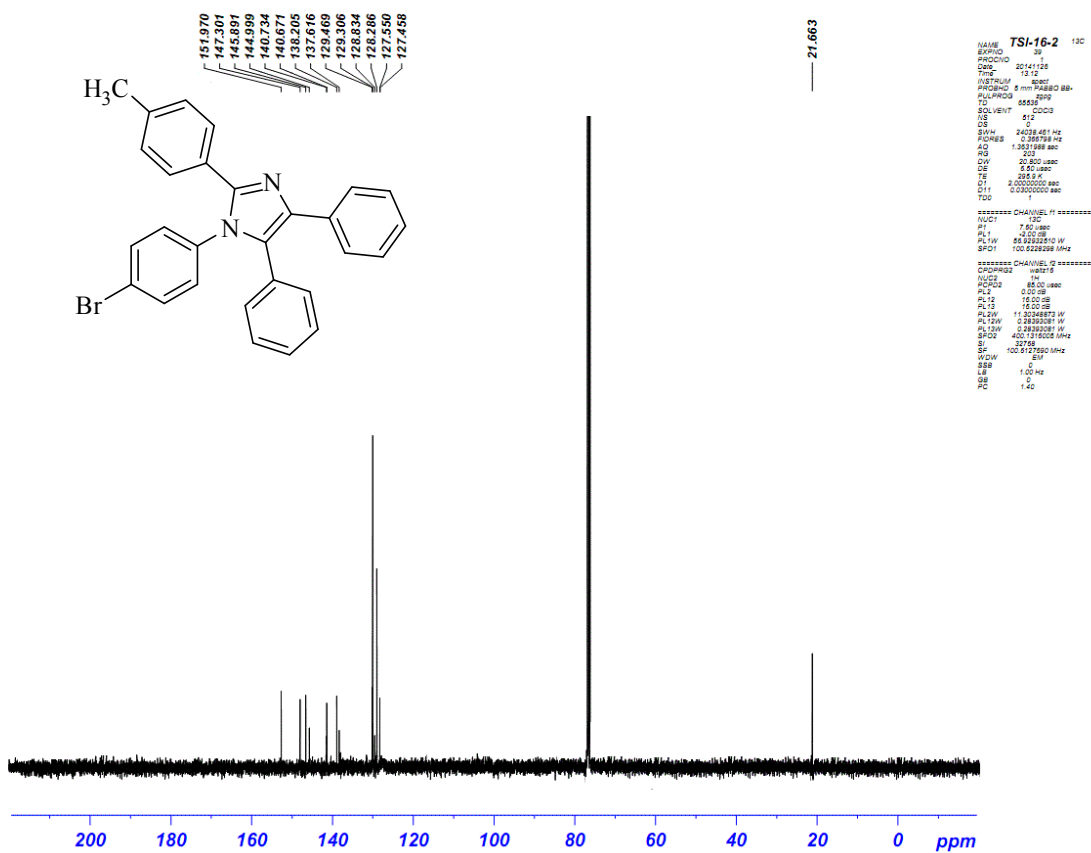


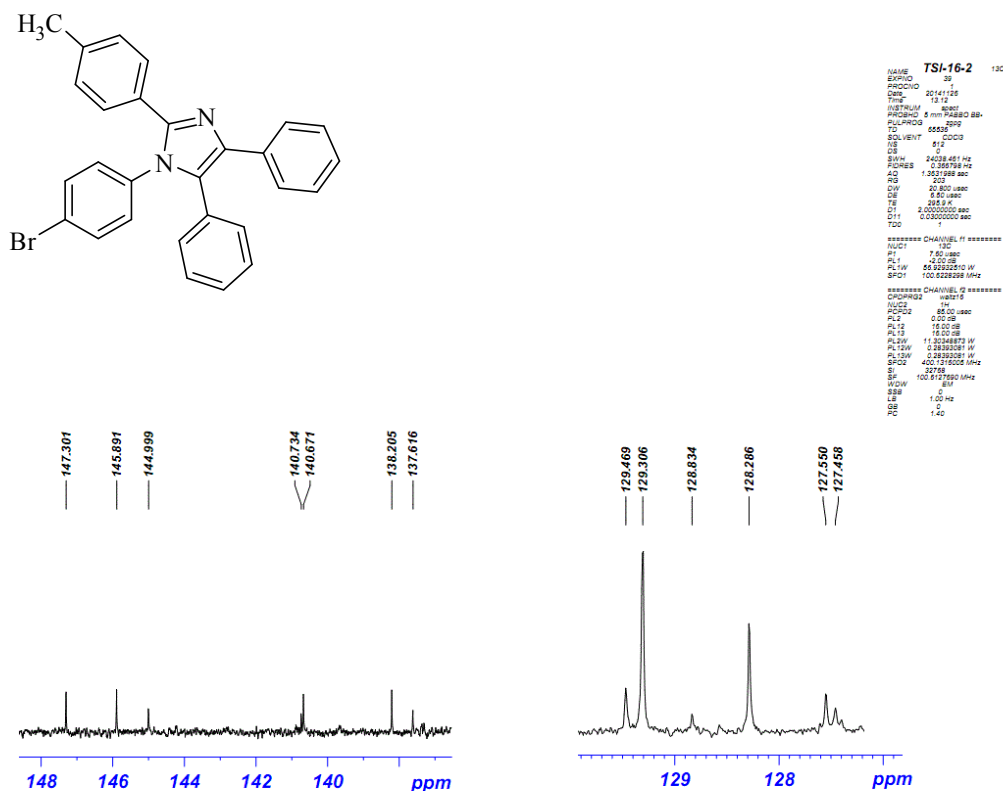
Fig. S63. The <sup>1</sup>H NMR spectrum of 1-(4-bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 10)



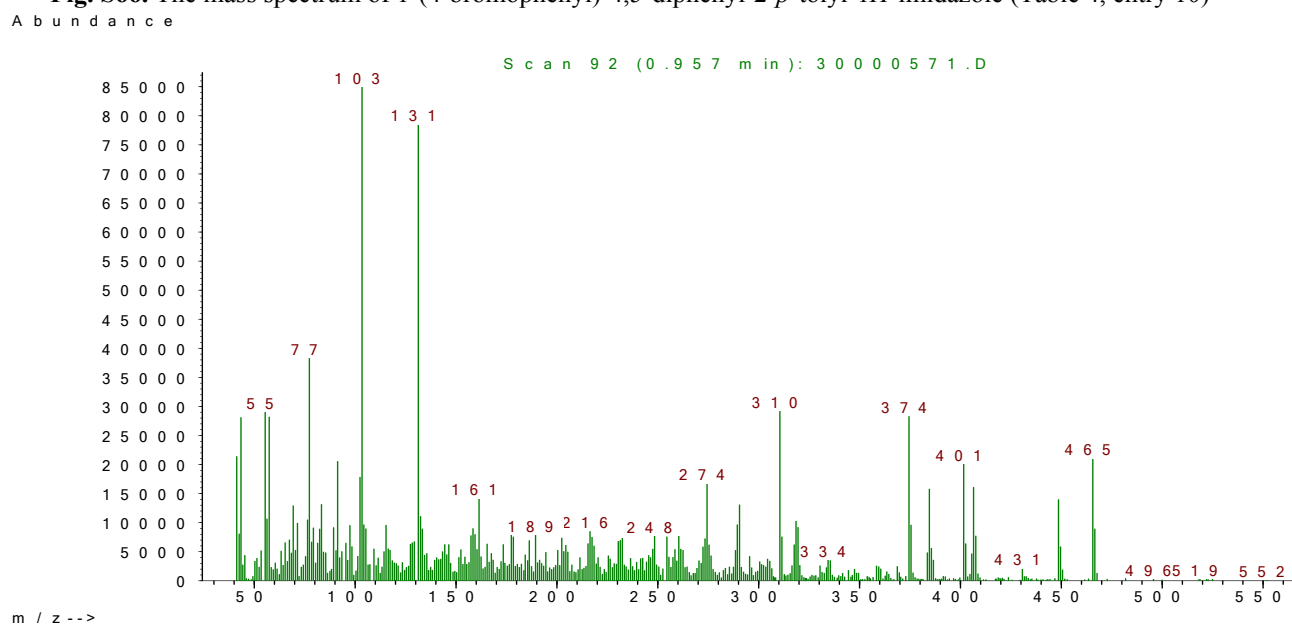
**Fig. S64.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 10)



**Fig. S65.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 10)

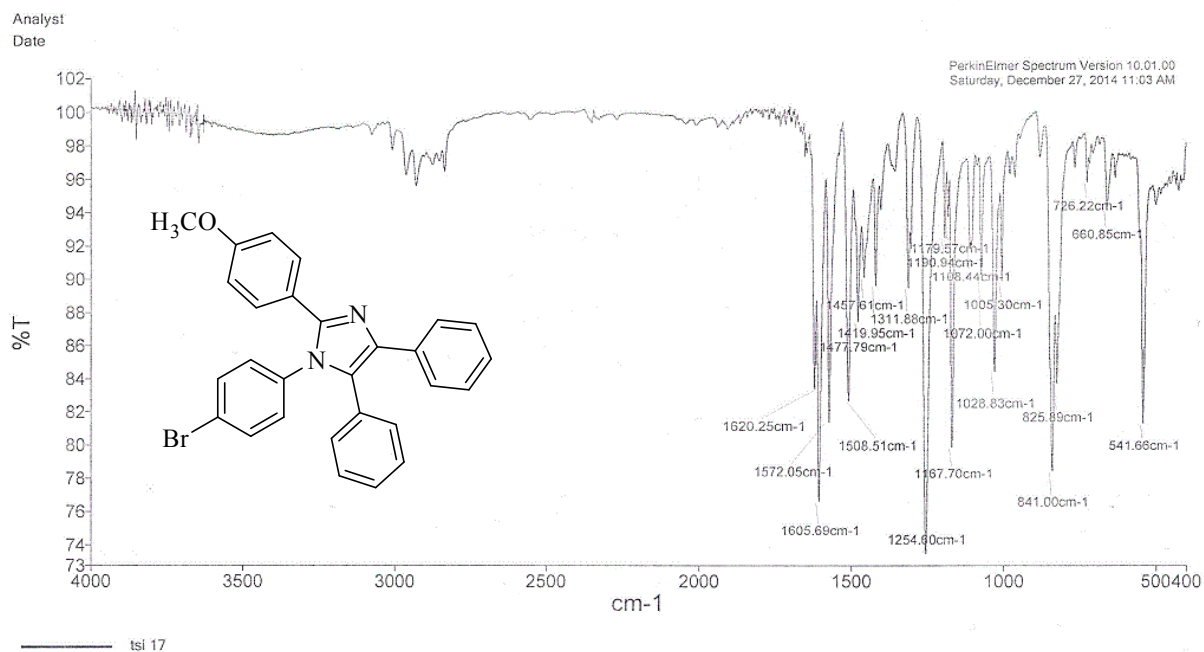


**Fig. S66.** The mass spectrum of 1-(4-bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (Table 4, entry 10)

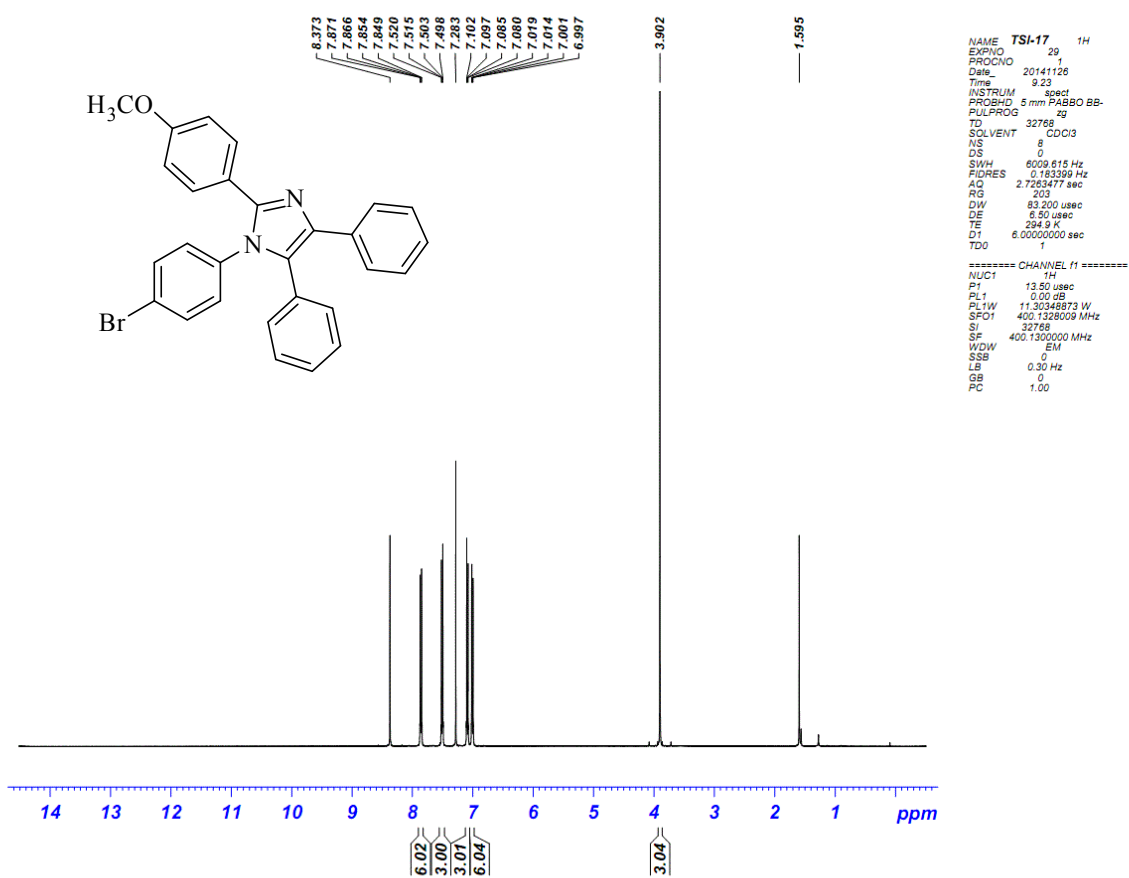




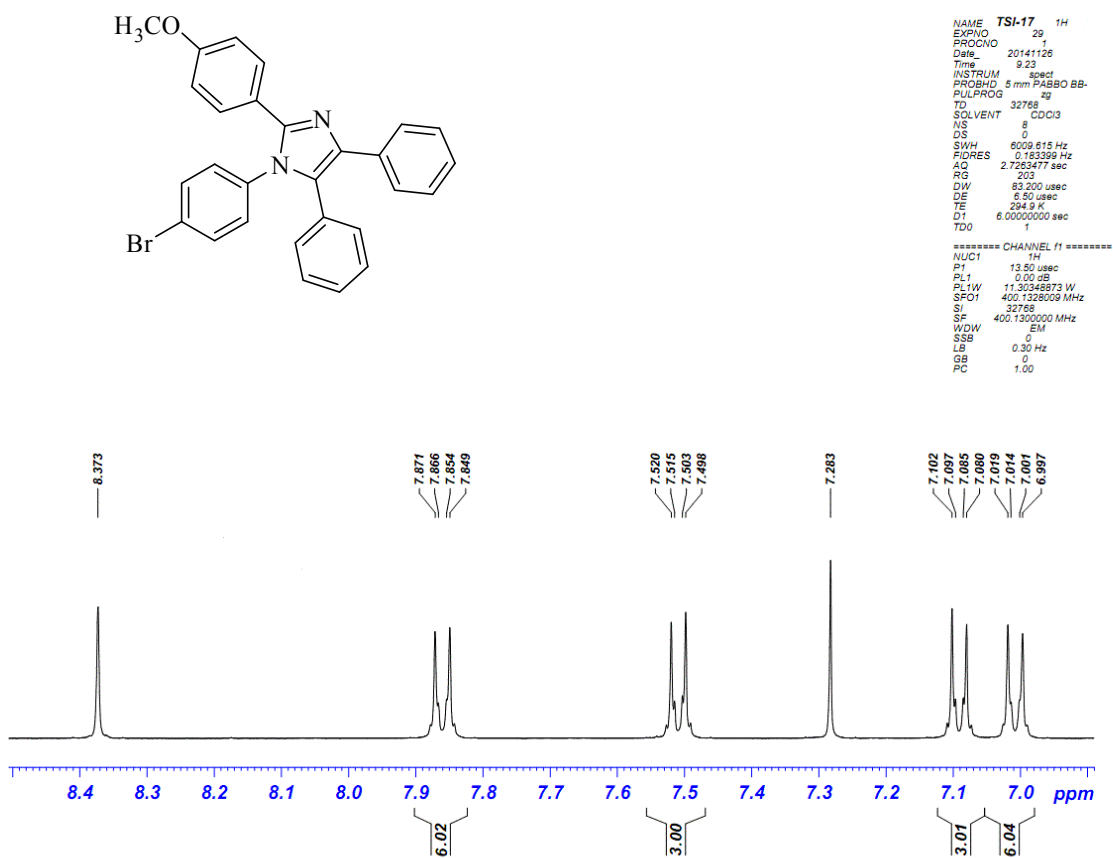
**Fig. S67.** The IR spectrum of 1-(4-bromophenyl)-2-(4-methoxyphenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 11)



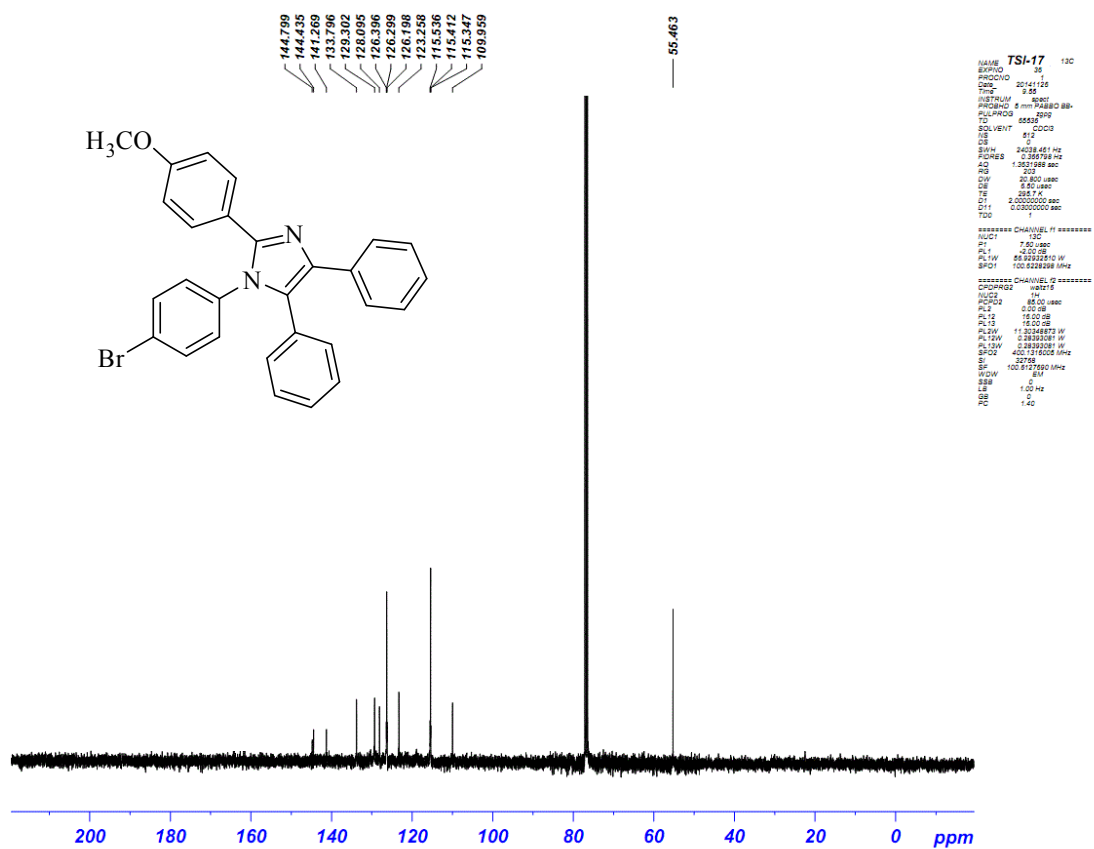
**Fig. S68.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-methoxyphenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 11)



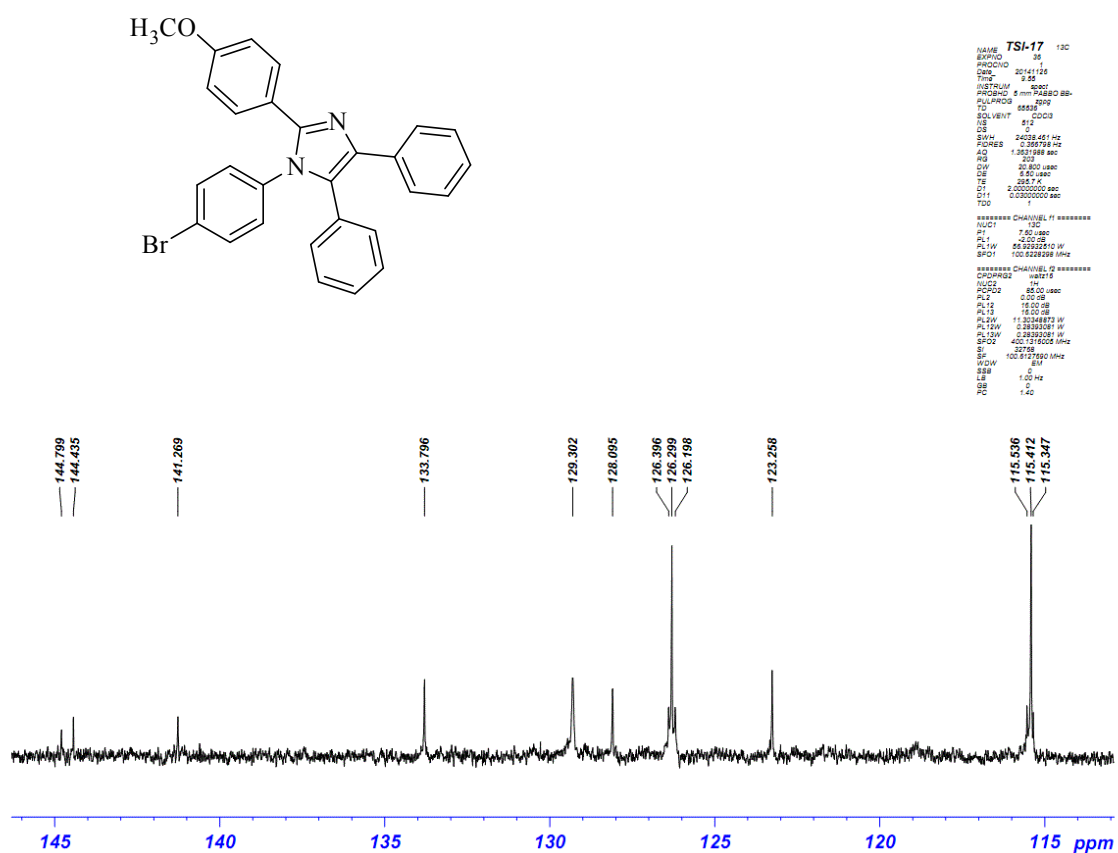
**Fig. S69.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-methoxyphenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 11)



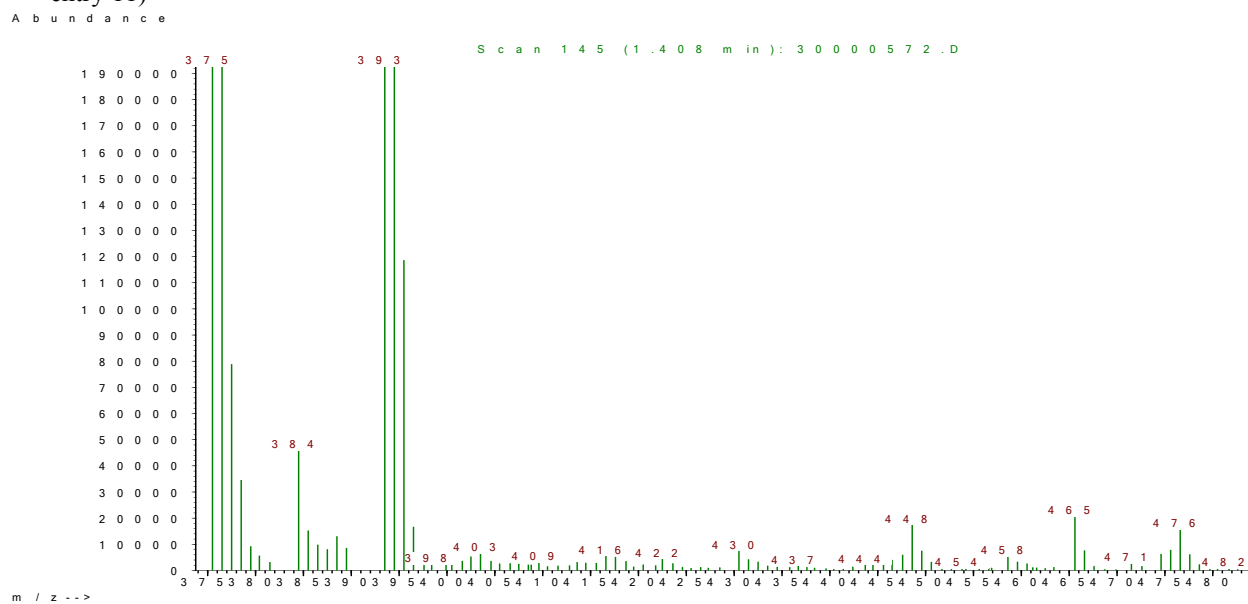
**Fig. S70.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-methoxyphenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 11)



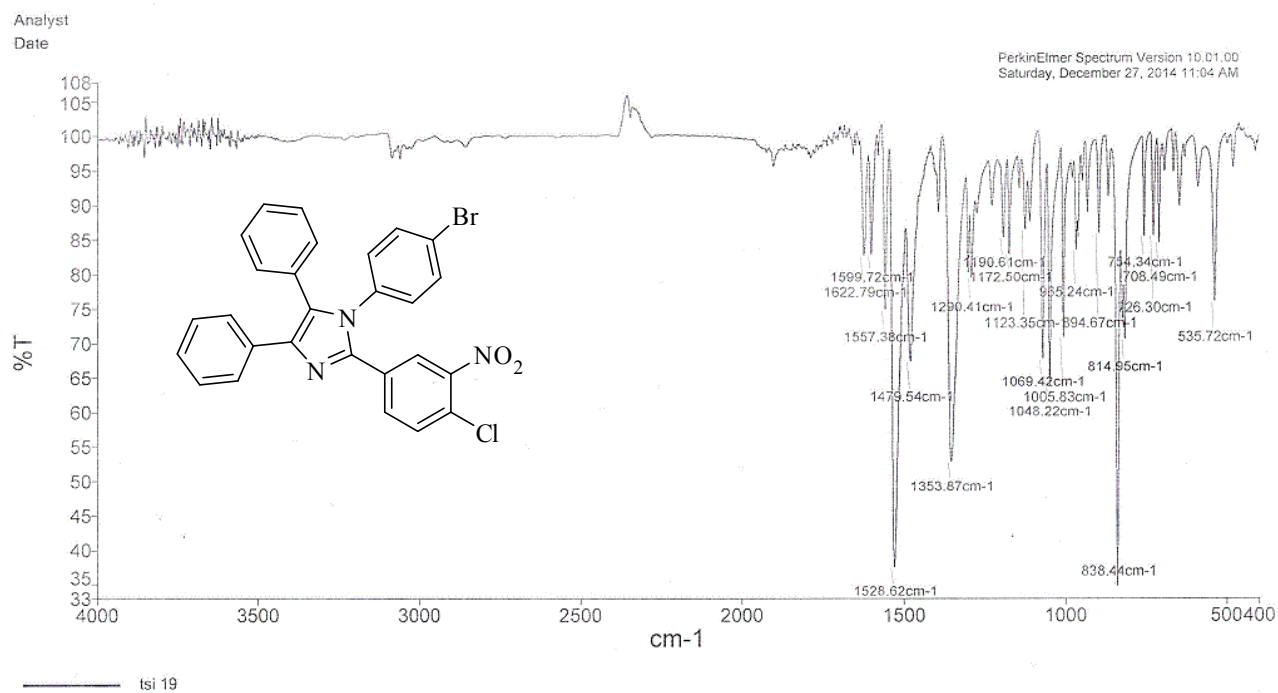
**Fig. S71.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-methoxyphenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 11)



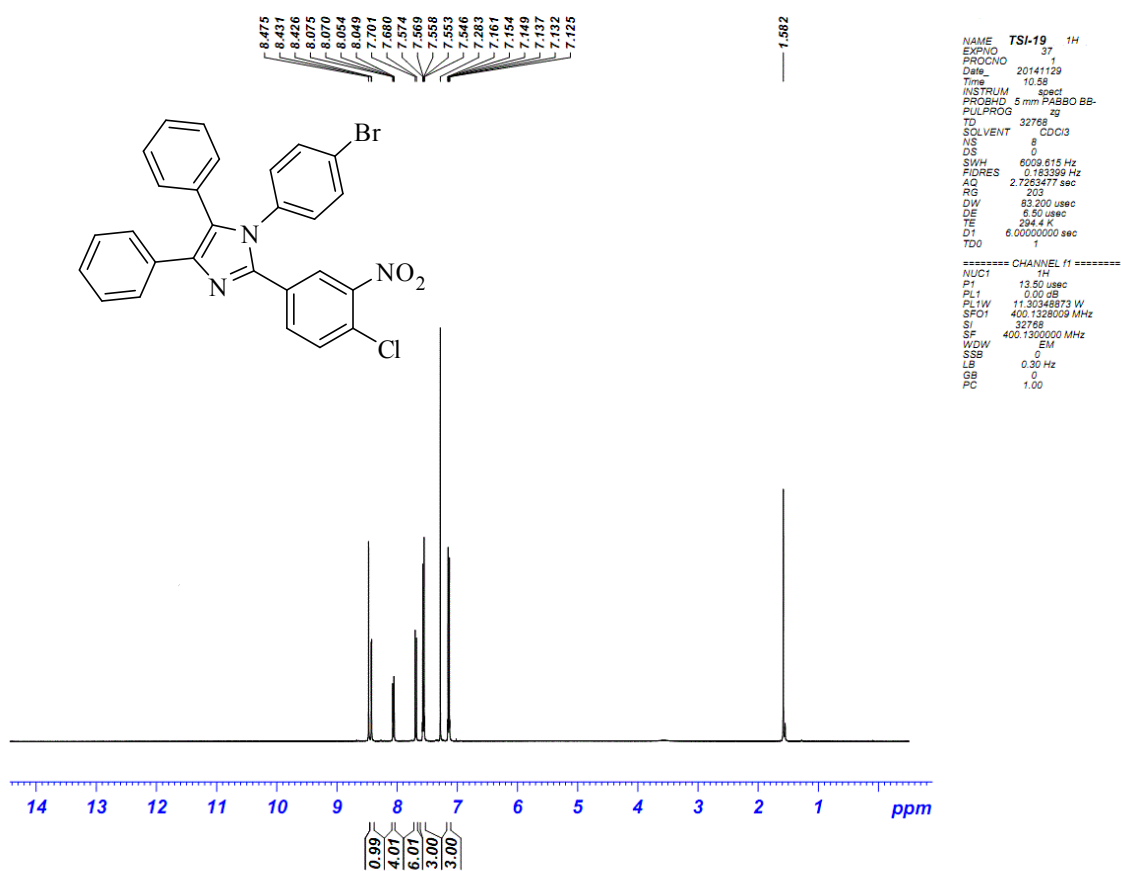
**Fig. S72.** The mass spectrum of 1-(4-bromophenyl)-2-(4-methoxyphenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 11)



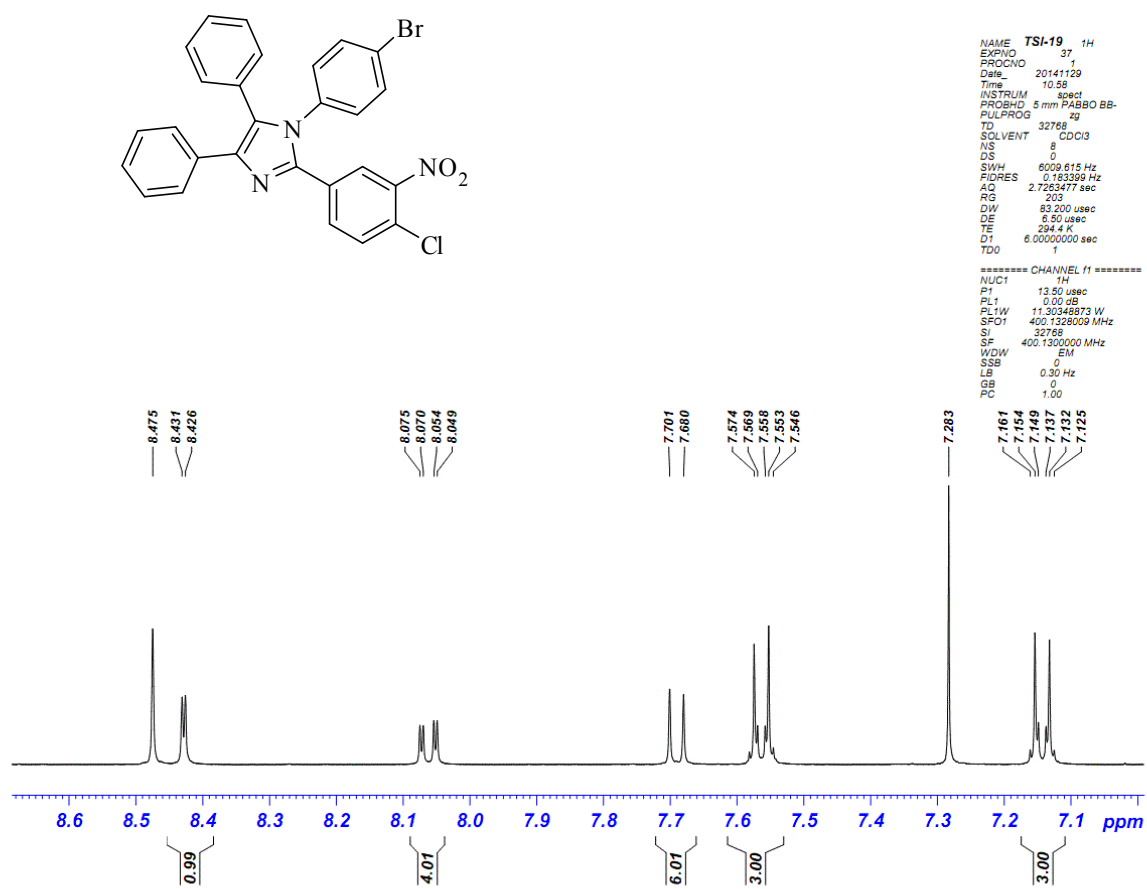
**Fig. S73.** The IR spectrum of 1-(4-bromophenyl)-2-(4-chloro-3-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 12)



**Fig. S74.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-chloro-3-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 12)

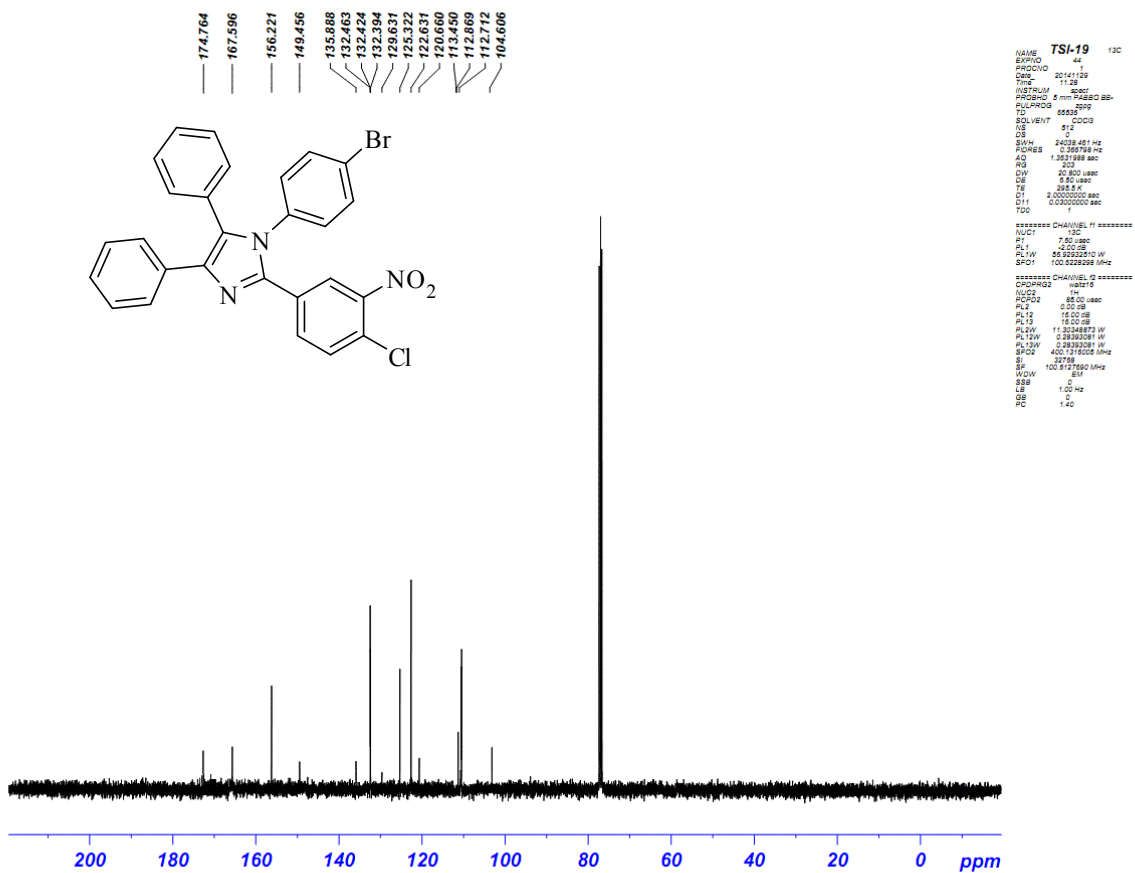


**Fig. S75.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-chloro-3-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 12)

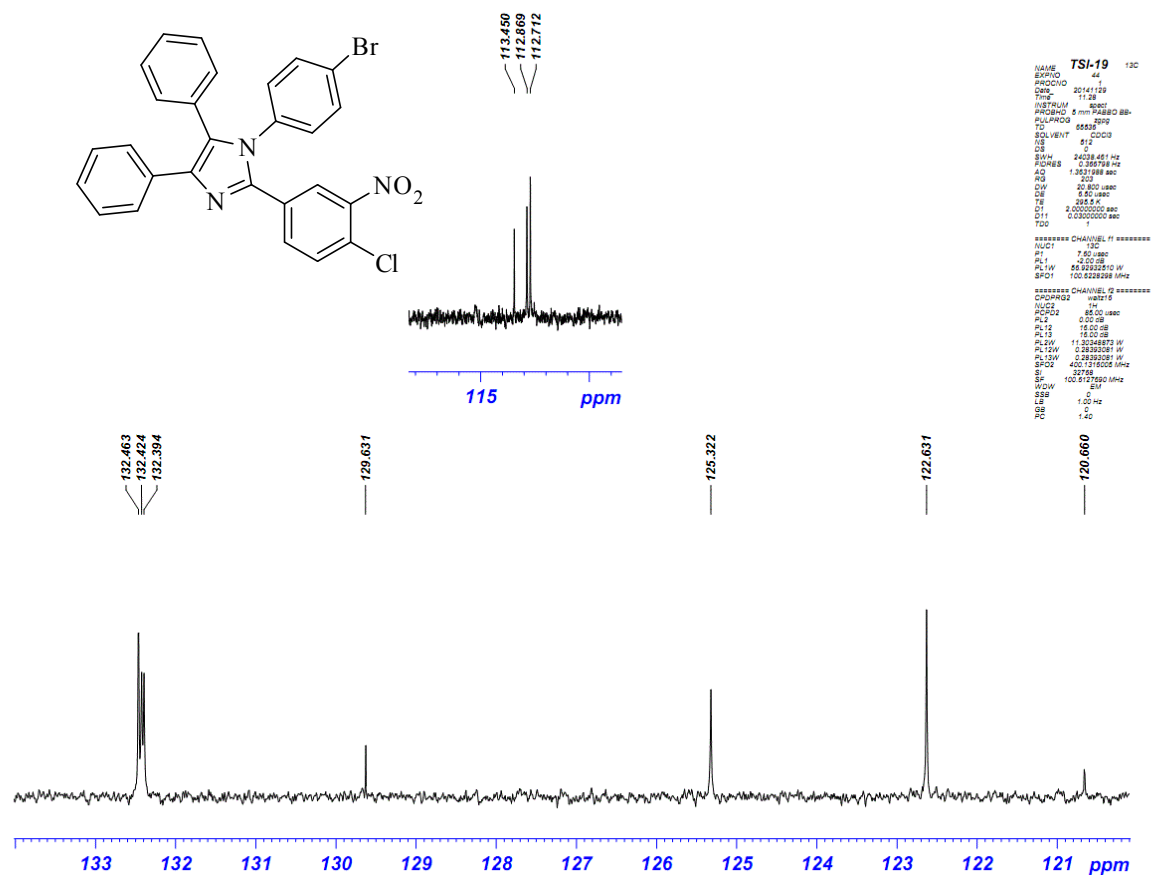




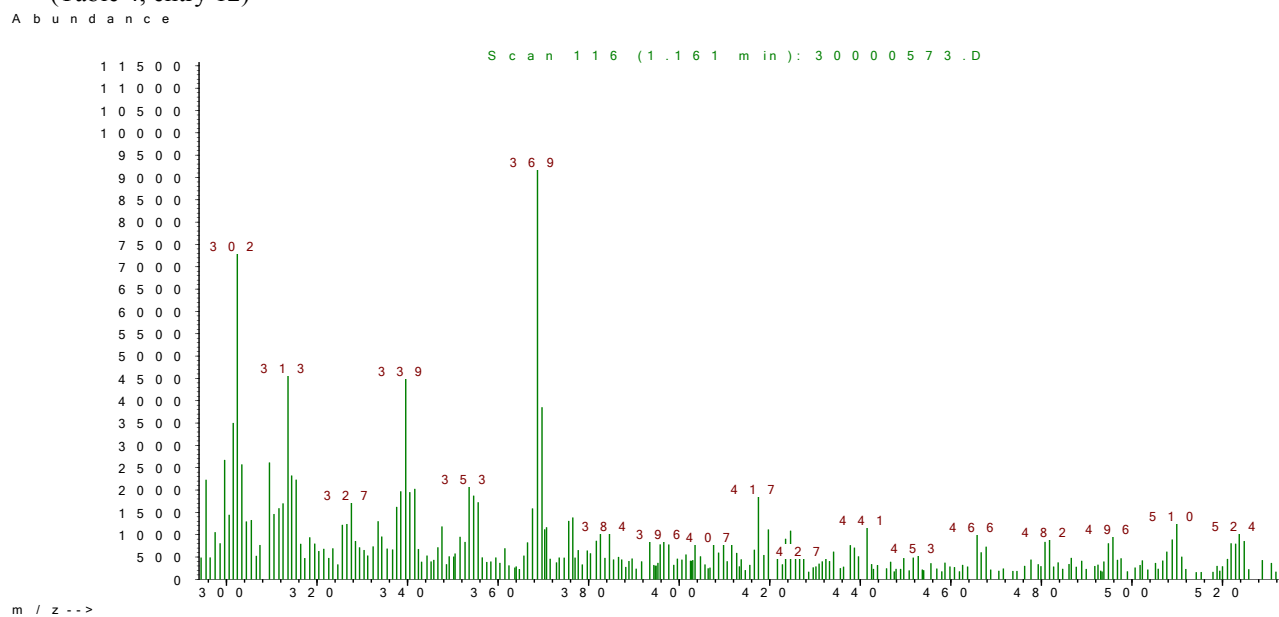
**Fig. S76.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-chloro-3-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 12)



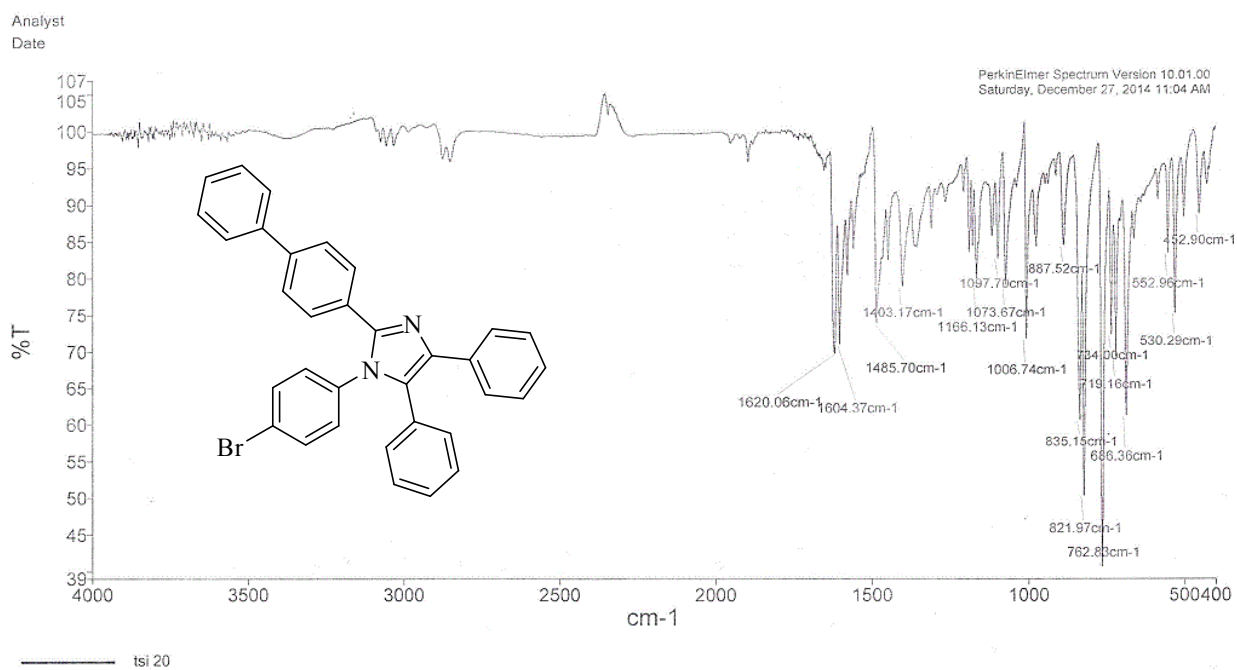
**Fig. S77.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(4-chloro-3-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 12)



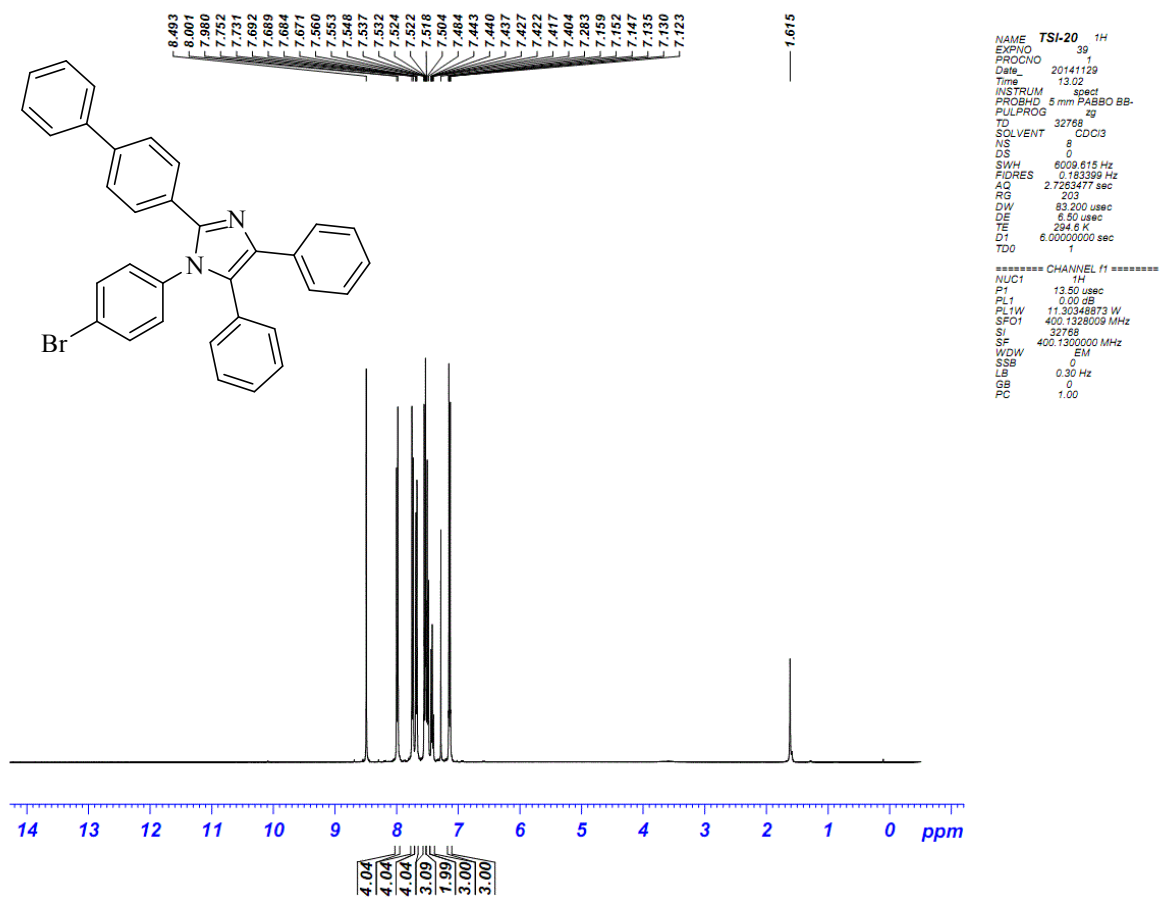
**Fig. S78.** The mass spectrum of 1-(4-bromophenyl)-2-(4-chloro-3-nitrophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 12)



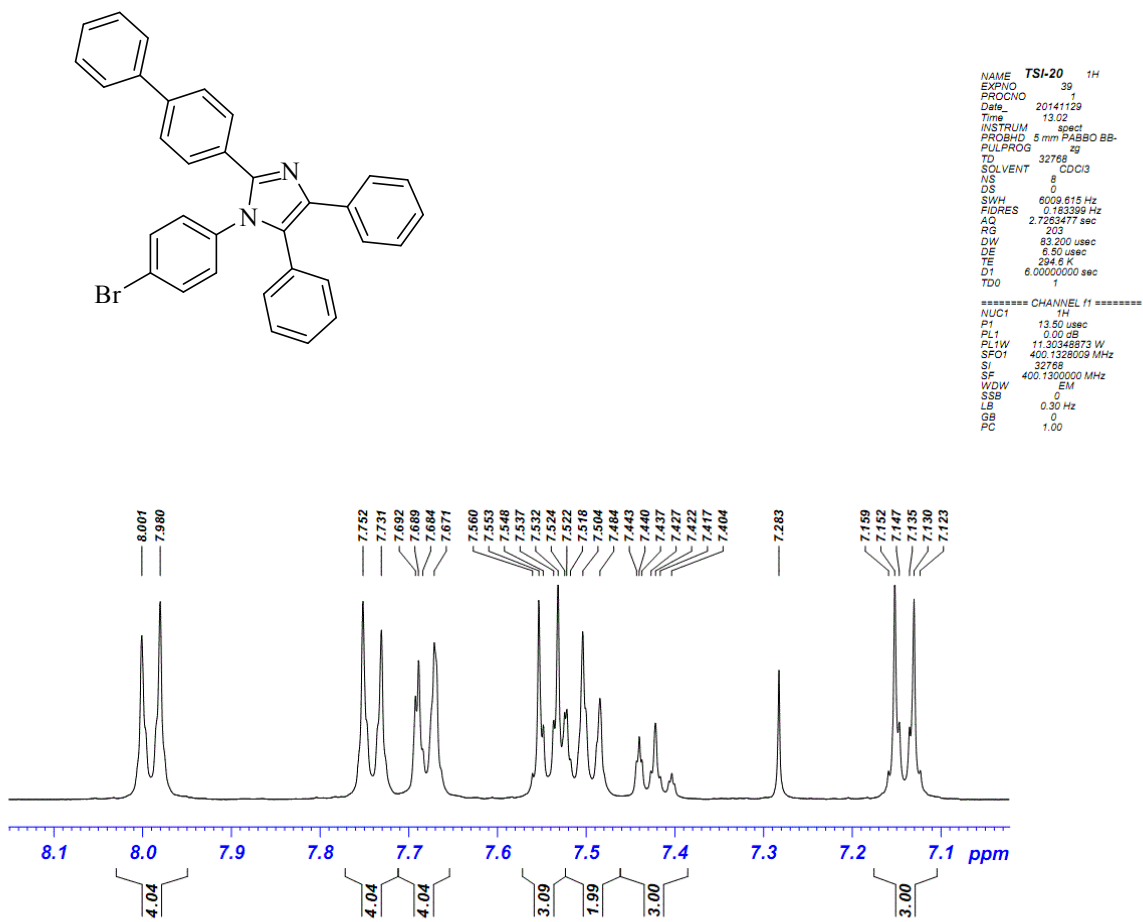
**Fig. S79.** The IR spectrum of 2-(biphenyl-4-yl)-1-(4-bromophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 13)



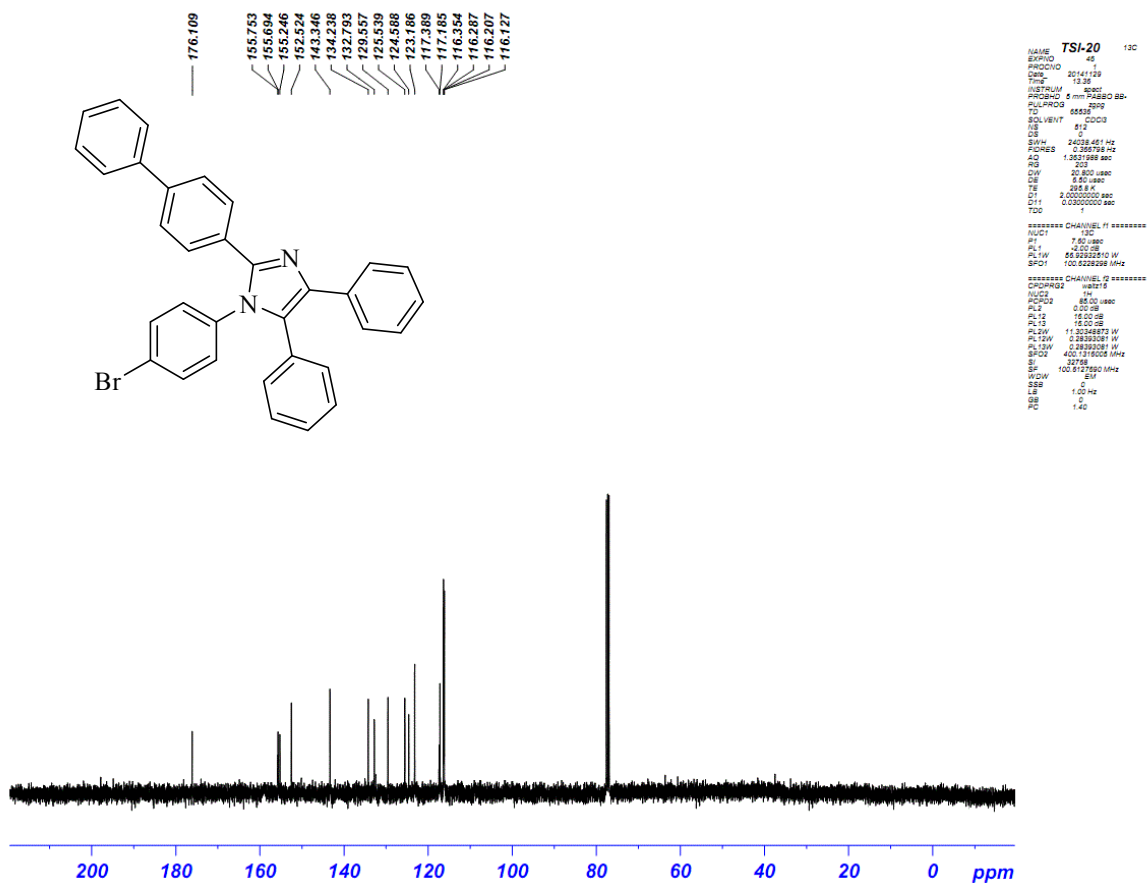
**Fig. S80.** The  $^1\text{H}$  NMR spectrum of 2-(biphenyl-4-yl)-1-(4-bromophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 13)



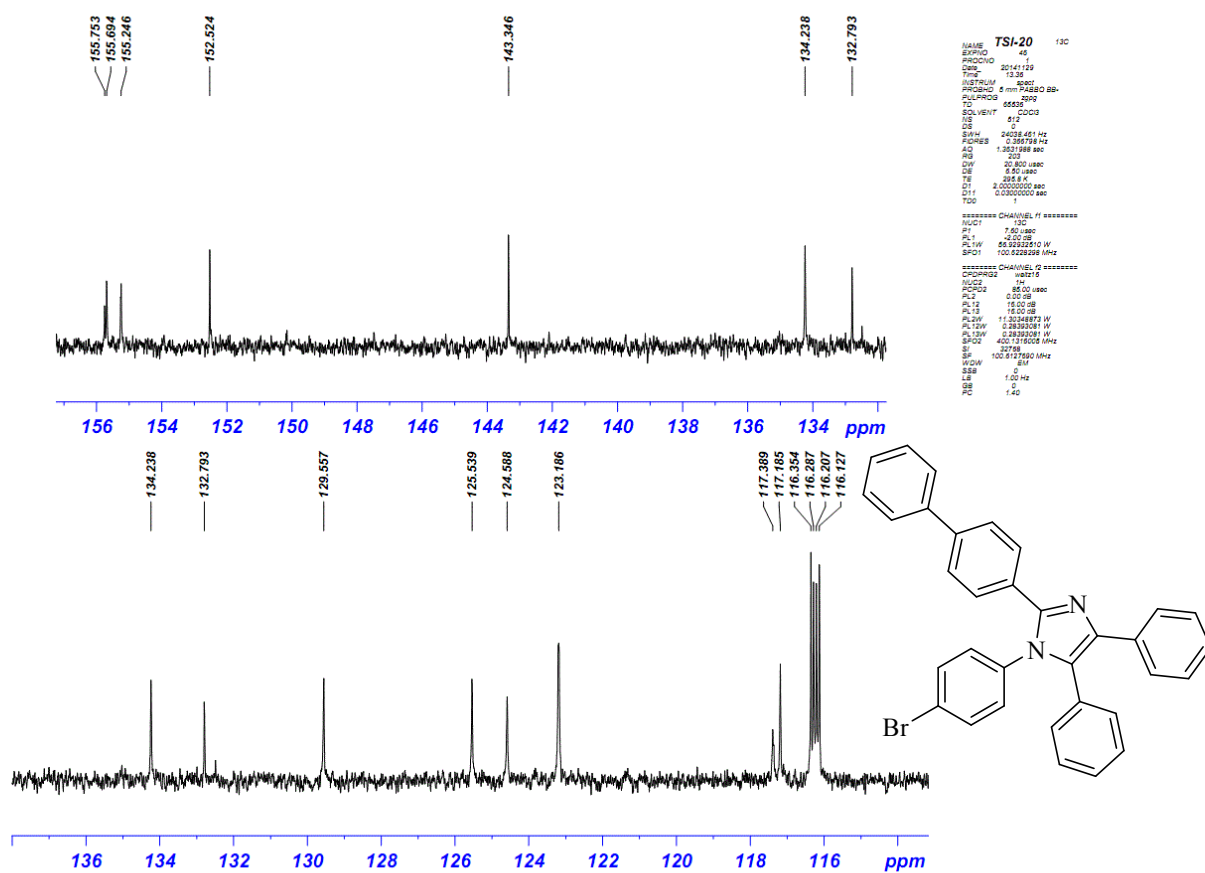
**Fig. S81.** The  $^1\text{H}$  NMR spectrum of 2-(biphenyl-4-yl)-1-(4-bromophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 13)



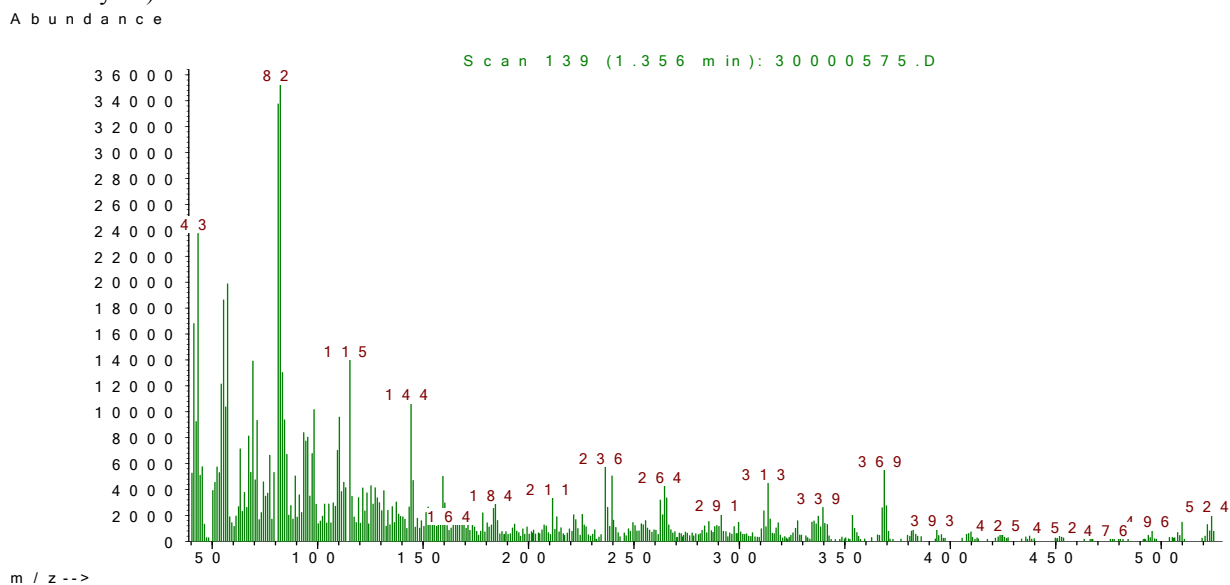
**Fig. S82.** The  $^{13}\text{C}$  NMR spectrum of 2-(biphenyl-4-yl)-1-(4-bromophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 13)



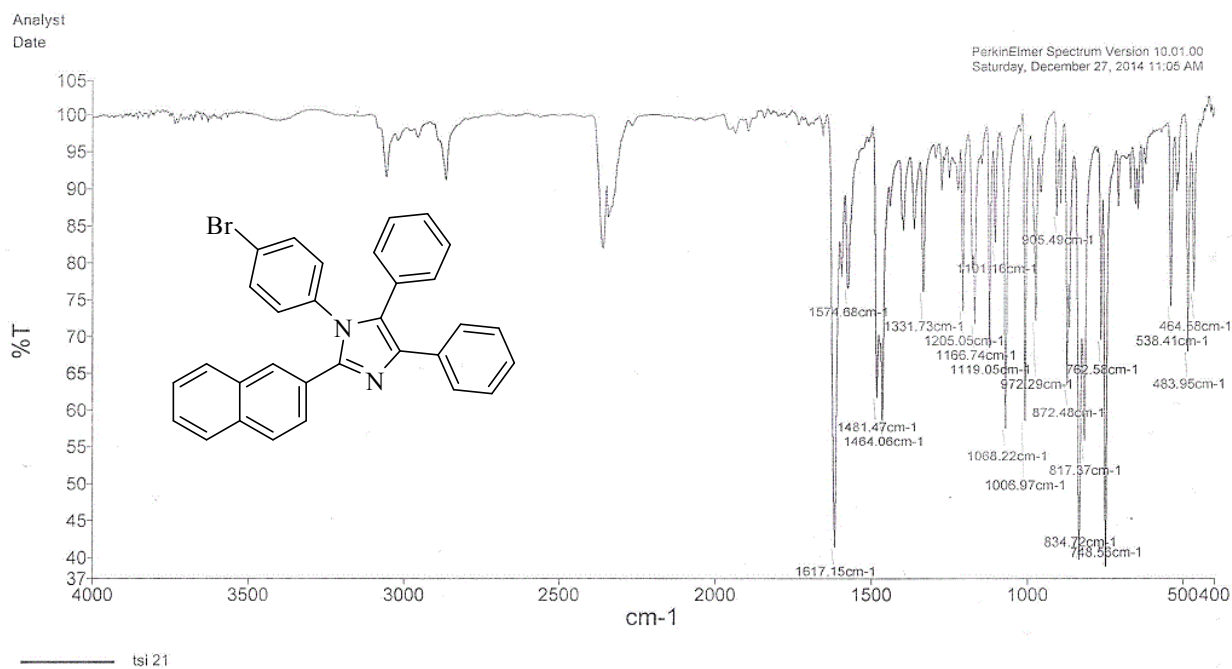
**Fig. S83.** The  $^{13}\text{C}$  NMR spectrum of 2-(biphenyl-4-yl)-1-(4-bromophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 13)



**Fig. S84.** The mass spectrum of 2-(biphenyl-4-yl)-1-(4-bromophenyl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 13)

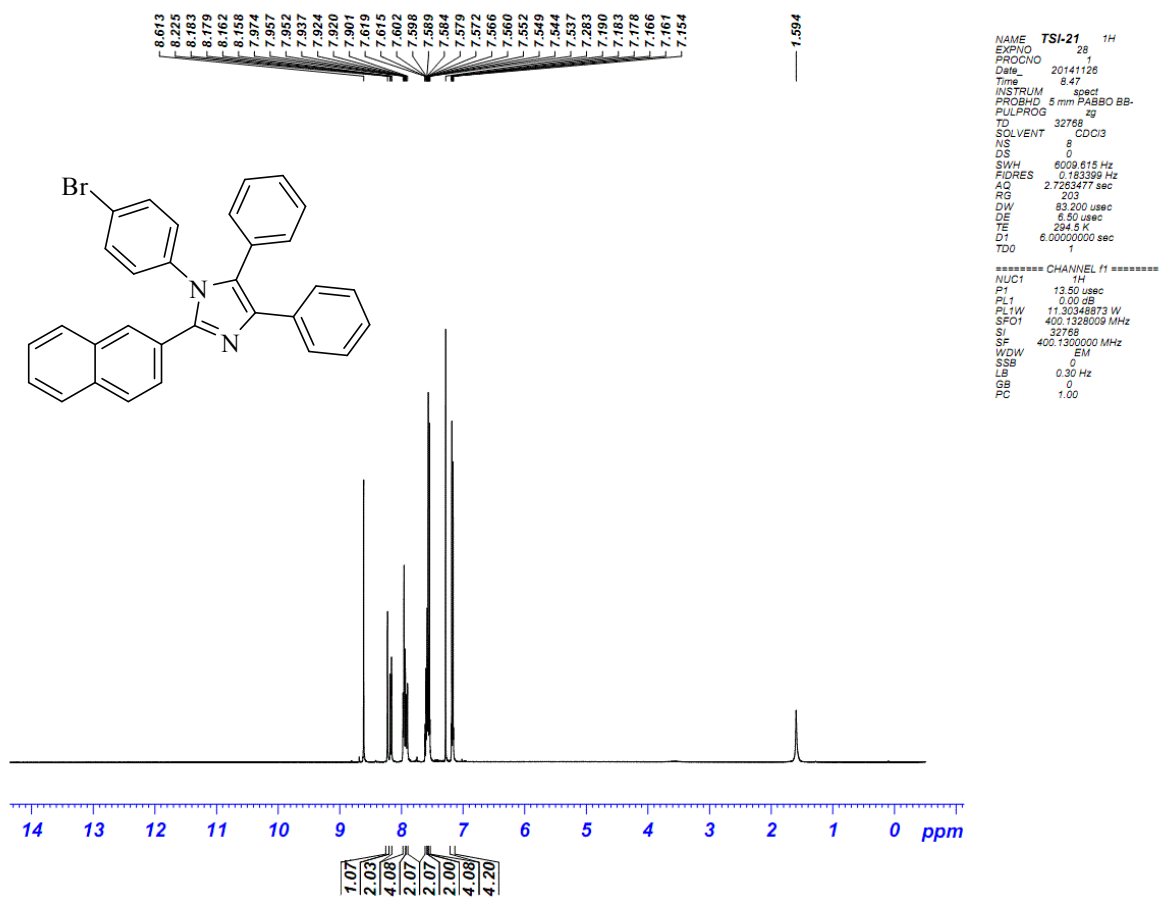


**Fig. S85.** The IR spectrum of 1-(4-bromophenyl)-2-(naphthalen-2-yl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 14)

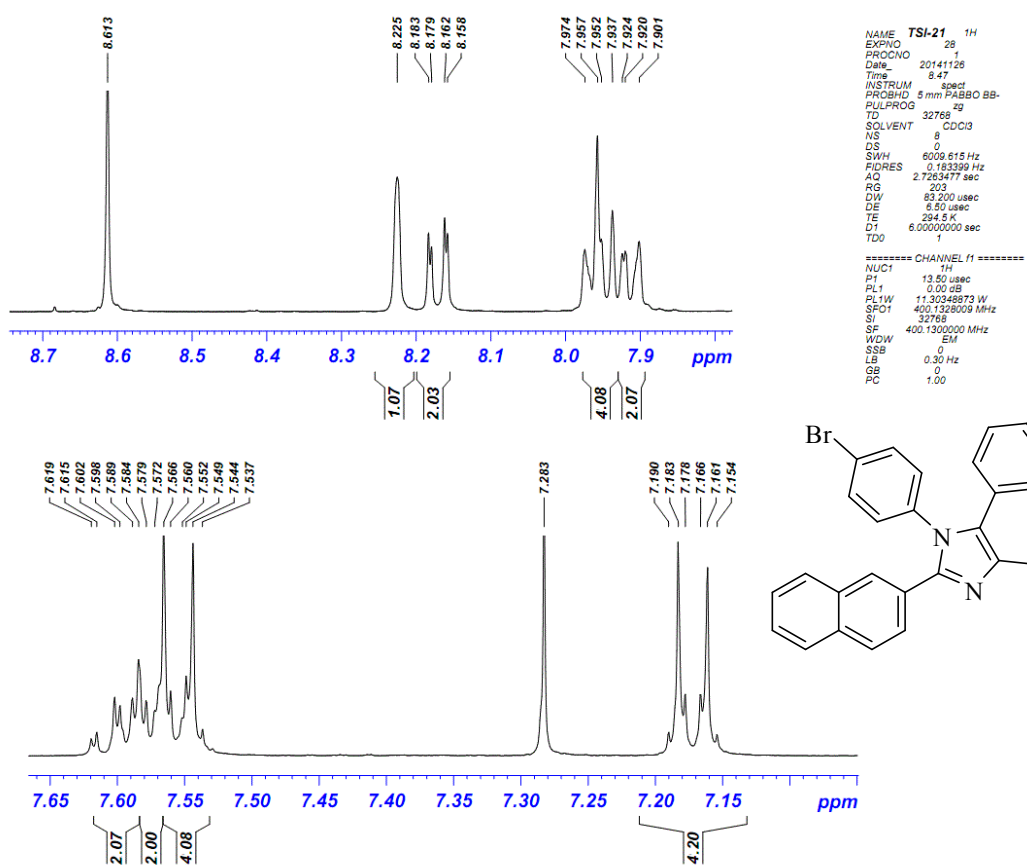




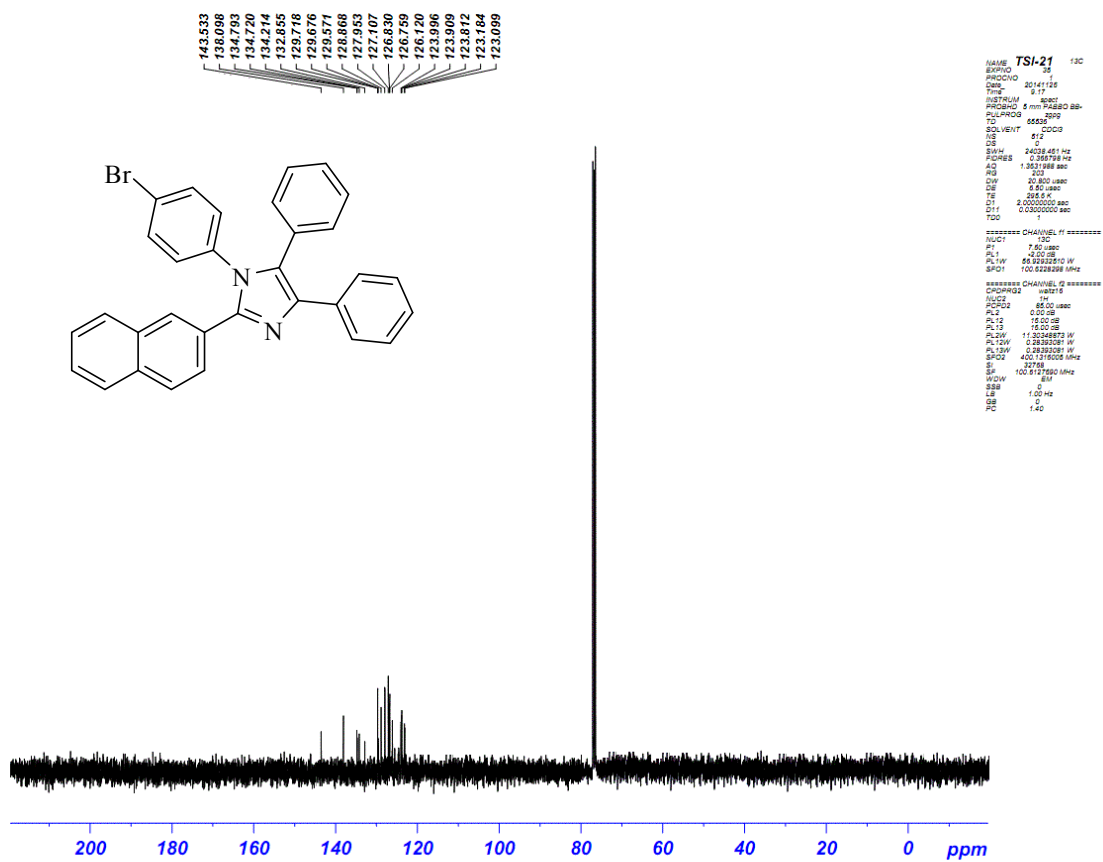
**Fig. S86.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(naphthalen-2-yl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 14)



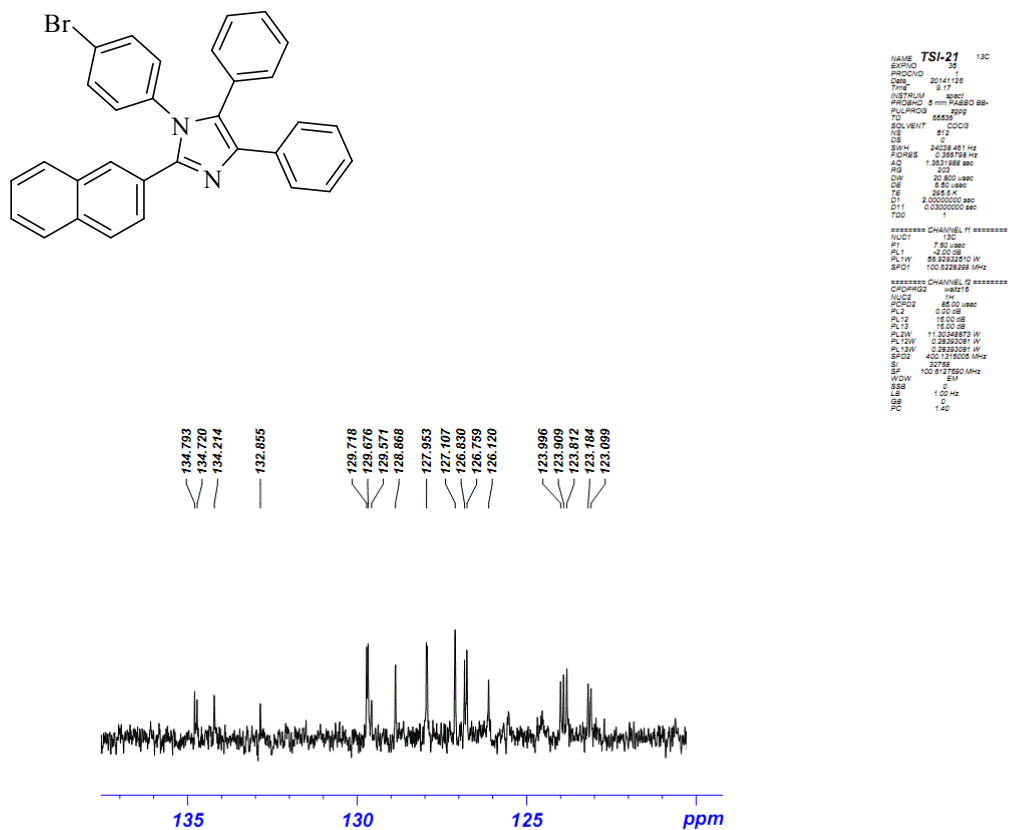
**Fig. S87.** The  $^1\text{H}$  NMR spectrum of 1-(4-bromophenyl)-2-(naphthalen-2-yl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 14)



**Fig. S88.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(naphthalen-2-yl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 14)



**Fig. S89.** The  $^{13}\text{C}$  NMR spectrum of 1-(4-bromophenyl)-2-(naphthalen-2-yl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 14)



**Fig. S90.** The mass spectrum of 1-(4-bromophenyl)-2-(naphthalen-2-yl)-4,5-diphenyl-1*H*-imidazole (Table 4, entry 14)

