**Synthesis of Novel Organosiliconsulfur-containing tetrasubstituted Imidazoles Core
Sonocatalyzed by $\text{La}_x\text{Sr}_{1-x}\text{Fe}_y\text{Co}_{1-y}\text{O}_3$ Nanoperovskites**

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SUPPLEMENTARY MATERIALS

Experimental

Chemicals were either prepared in our laboratory or purchased from Merck, Fluka and Aldrich. Commercial products were used without further purification. The ^1H NMR and ^{13}C NMR spectra were recorded with a Bruker FT-400 MHz spectrometer at room temperature and with CDCl_3 and/or DMSO-d_6 as solvent. The FT-IR spectra were recorded on a Bruker Tensor 270 spectrometer. The reactions were carried out using an ultrasonic processor probe (SONOPULS Ultrasonic homogenizers). The Elemental analyses were carried out with an Elementar vario EL III instrument. The abbreviations used for NMR signals are: s = singlet, d = doublet, t = triplet and m = multiplet. Melting points were recorded on a Büchi B-545 apparatus in open capillary tubes and are uncorrected.

General procedure for preparation of 1,2,4,5-tetrasubstituted imidazoles 1a–1m

A mixture of benzil (1 mmol), aldehyde (1 mmol), amine (1 mmol), and ammonium acetate (1.1 mmol) as ammonia source and 3 mol% of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Fe}_{0.34}\text{Co}_{0.66}\text{O}_3$ in 3 mL water was introduced in a 20 mL heavy walled pear-shaped two necked flask with nonstandard tapered outer joint. The flask was attached to a 12 mm tip diameter probe and the reaction mixture was sonicated at ambient temperature at 20% power of the processor. After completion of the reaction (monitored by TLC, within 3–6 min), the solid product was filtered, washed with water, dried and recrystallised from ethanol. The supported reagent was washed three times with ethanol and dried under vacuum before reuse. The spectral data of some selected products are given below:

1-(4-Fluorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (1b)

White powder (96%), mp 188–190 °C ^[24], IR (KBr, cm^{-1}): ν_{max} = 3058 (Ar–H), 2962 (C–H), 1602, 1508, 1444 (C=C), 960, 775, 730. ^1H NMR (CDCl_3 , 400 MHz) δ_{H} : 2.36 (s, 3H, CH_3), 6.96–7.00 (m, 2H, Ar–H), 7.03–7.07 (m, 2H, Ar–H), 7.11 (d, 2H, J = 8.0 Hz, Ar–H), 7.14–7.17 (m, 2H, Ar–H), 7.21–7.32 (m, 6H, Ar–H), 7.35 (d, 2H, J = 8.0 Hz, Ar–H), 7.63 (d, 2H, J = 7.2 Hz, Ar–H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : 20.24 (CH_3), 114.95, 115.17, 125.58, 126.32, 126.41, 127.01, 127.12, 127.41, 127.79, 127.88, 128.99, 129.08, 129.50, 129.58, 130.07, 132.19, 133.30, 137.16, 137.31, 146.12, 159.59, 162.06 (Ar). Anal.Calc. for $\text{C}_{28}\text{H}_{21}\text{FN}_2$: C, 83.14; H, 5.23; N, 6.93%. Found: C, 83.09; H, 5.14; N, 6.81%.

^1H NMR spectrum of 1-(4-fluorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (**1b**) in CDCl_3

^{13}C NMR spectrum of 1-(4-fluorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (**1b**) in CDCl_3

1-(3-Chlorophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (1d)

White powder (94%), mp 198–200 °C ^[24], IR (KBr, cm⁻¹): $\nu_{\max}$ = 3056 (Ar-H), 2963 (C-H), 1600, 1490, 1479 (C=C), 739, 703. ¹H NMR (CDCl₃, 400 MHz) δ_{H} : 2.33 (s, 3H, CH₃), 6.93–6.95 (m, 1H, Ar-H), 7.05 (t, J = 1.86 Hz, 1H, Ar-H), 7.08 (d, 2H, J = 8.04 Hz, Ar-H), 7.12–7.27 (m, 10H, Ar-H), 7.32 (d, 2H, J = 8.15 Hz, Ar-H), 7.58–7.60 (m, 2H, Ar-H). ¹³C NMR (CDCl₃, 100 MHz) δ_{C} : 20.27 (CH₃), 125.64, 125.77, 126.24, 126.33, 127.14, 127.15, 127.47, 127.58, 127.78, 127.95, 128.92, 129.31, 130.05, 133.21, 133.48, 137.33, 137.45, 146.00 (Ar). Anal. Calc. for C₂₈H₂₁ClN₂: C, 79.89; H, 5.03; N, 6.66%. Found: C, 79.78; H, 5.12; N, 6.74%.

¹H NMR spectrum of 1-(3-chlorophenyl)-4,5-diphenyl-2-*p*-tolyl-1H-imidazole (**1d**) in CDCl₃

¹³C NMR spectrum of 1-(3-chlorophenyl)-4,5-diphenyl-2-*p*-tolyl-1H-imidazole (**1d**) in CDCl₃

4-(2,4,5-Triphenyl-1*H*-imidazol-1-yl)phenol (1e)

White powder (95%), mp > 280 °C ^[24], IR (KBr, cm⁻¹): ν_{max} = 3414 (Ar-OH), 3054 (Ar-H), 2922 (C-H), 1604, 1513, 1446 (C=C), 696. ¹H NMR (CDCl₃, 400 MHz) δ_{H} : 6.66 (d, *J* 8.5 Hz, 2H, Ar-H), 7.04 (d, *J* = 8.5 Hz, 2H, Ar-H), 7.14–7.30 (m, 11H, Ar-H), 7.42–7.44 (m, 2H, Ar-H), 7.49 (d, *J* = 7.5, 2H, Ar-H), 9.78 (s, 1H, Ar-OH). ¹³C NMR (DMSO-d₆, 100 MHz) δ_{C} : 115.59, 126.35, 127.84, 128.12, 128.15, 128.27, 128.40, 129.79, 130.58, 130.63, 131.12, 131.59, 134.56, 136.61, 146.11, 157.31 (Ar). Anal.Calc. for C₂₇H₂₀N₂O: C, 83.48; H, 5.19; N, 7.21. Found: C, 83.54; H, 5.07; N, 7.19%.

¹H NMR spectrum of 4-(2,4,5-triphenyl-1H-imidazol-1-yl)phenol (**1e**) in DMSO-d₆

¹³C NMR spectrum of 4-(2,4,5-triphenyl-1H-imidazol-1-yl)phenol (**1e**) in DMSO-d₆

4-(2-(4-Chlorophenyl)-4,5-diphenyl-1*H*-imidazol-1-yl)phenol (1f)

White powder (93%), mp > 280 °C ^[24], IR (KBr, cm⁻¹): ν_{max} = 3416 (Ar-OH), 3054 (Ar-H), 2926 (C-H), 1595, 1513, 1478, 1440 (C=C), 745, 695. ¹H NMR (DMSO-d₆, 400 MHz) δ_{H} : 6.67 (d, J = 8.4 Hz, 2H, Ar-H), 7.05 (d, J = 8.4 Hz, 2H, Ar-H), 7.14–7.43 (m, 12H, Ar-H), 7.47 (d, J = 7.5 Hz, 2H, Ar-H), 9.82 (s, 1H, Ar-OH). ¹³C NMR (DMSO-d₆, 100 MHz) δ_{C} : 115.69, 126.33, 126.46, 127.55, 128.15, 128.27, 128.37, 128.43, 129.37, 129.71, 129.74, 130.44, 131.10, 131.89, 132.98, 134.37, 136.76, 144.96, 157.42 (Ar). Anal.Calc. for C₂₇H₁₉ClN₂O: C, 76.68; H, 4.53; N, 6.62%. Found: C, 76.49; H, 4.61; N, 6.58%.

¹H NMR spectrum of 4-(2-(4-chlorophenyl)-4,5-diphenyl-1H-imidazol-1-yl)phenol (**1f**) in DMSO-d₆

¹³C NMR spectrum of 4-(2-(4-chlorophenyl)-4,5-diphenyl-1H-imidazol-1-yl)phenol (**1f**) in DMSO-d₆

4,4'-(4,5-Diphenyl-1*H*-imidazole-1,2-diyl)diphenol (1h)

White powder (92%), mp > 280 °C ^[24], IR (KBr, cm⁻¹): ν_{max} = 3416 (Ar–OH), 3053 (Ar–H), 2924 (C–H), 1642, 1513, 1438 (C=C), 694. ¹H NMR (DMSO-*d*₆, 400 MHz) δ_{H} : 6.64–6.67 (m, 4H, Ar–H), 7.00 (d, *J* = 8.4, 2H, Ar–*H*), 7.12–7.29 (m, 10H, Ar–H), 7.45 (d, *J* = 7.7, 2H, Ar–H), 9.73 (bs, 2H, Ar–OH). ¹³C NMR (DMSO-*d*₆, 100 MHz) δ_{C} : 114.92, 115.55, 121.48, 126.22, 126.31, 128.05, 128.09, 128.16, 128.39, 129.67, 129.84, 130.86, 130.89, 131.14, 134.75, 136.15, 146.56, 157.19, 157.52 (Ar). Anal.Calc. for C₂₇H₂₀N₂O₂: C, 80.18; H, 4.98; N, 6.93%. Found: C, 80.01; H, 4.75; N, 6.87%.

¹H NMR spectrum of 4,4'-(4,5-diphenyl-1H-imidazole-1,2-diyl)diphenol (**1h**) in DMSO-d₆

¹³C NMR spectrum of 4,4'-(4,5-diphenyl-1H-imidazole-1,2-diyl)diphenol (**1h**) in DMSO-d₆

2-(4-Chlorophenyl)-4,5-diphenyl-1-*p*-tolyl-1*H*-imidazole (1k)

White powder (94%), mp 167–169 °C ^[24], IR (KBr, cm⁻¹): $\nu_{\max}$ = 3054 (Ar-H), 2976 (C-H), 1510, 1478, 1445 (C=C), 745, 696. . ¹H NMR (CDCl₃, 400 MHz) δ_{H} : 2.36 (s, 3H, CH₃), 6.95 (d, J = 8.1 Hz, 2H, Ar-H), 7.10 (d, J = 8.1 Hz, 2H, Ar-H), 7.16–7.18 (m, 2H, Ar-H), 7.21–7.30 (m, 8H, Ar-H), 7.41–7.43 (m, 2H, Ar-H), 7.61–7.63 (m, 2H, Ar-H). ¹³C NMR (CDCl₃, 100 MHz) δ_{C} : 20.14 (CH₃), 119.77, 125.61, 126.30, 126.95, 126.99, 127.13, 127.29, 127.31, 128.10, 128.82, 129.03, 129.50, 130.05, 130.17, 133.15, 133.21, 133.31, 137.41, 144.74 (Ar). Anal.Calc. for C₂₈H₂₁ClN₂: C, 79.89; H, 5.03; N, 6.66%. Found: C, 79.76; H, 5.14; N, 6.86%.

¹H NMR spectrum of 2-(4-Chlorophenyl)-4,5-diphenyl-1-*p*-tolyl-1H-imidazole (**1k**) in CDCl₃

¹³C NMR spectrum of 2-(4-Chlorophenyl)-4,5-diphenyl-1-*p*-tolyl-1H-imidazole (**1k**) in CDCl₃

1-(4-Bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (11)

White powder (93%), mp 190–192 °C ^[24], IR (KBr, cm⁻¹): $\nu_{\max}$ = 3057 (Ar-H), 2961 (C-H), 1570, 1510, 1478 (C=C), 726, 697. ¹H NMR (CDCl₃, 400 MHz) δ_{H} : 2.36 (s, 3H, CH₃), 6.93 (d, *J* 8.6 Hz, 2H, Ar-H), 7.11–7.17 (m, 4H, Ar-H), 7.20–7.35 (m, 8H, Ar-H), 7.41 (d, 2H, *J* 8.6 Hz, Ar-H), 7.60–7.62 (m, 2H, Ar-H). ¹³C NMR (CDCl₃, 100 MHz) δ_{C} : 20.27 (CH₃), 121.06, 121.58, 125.64, 126.37, 127.14, 127.51, 127.88, 127.96, 128.56, 128.91, 129.35, 129.44, 130.10, 131.13, 131.25, 133.27, 135.27, 137.42, 146.04 (Ar). Anal.Calc. for C₂₈H₂₁BrN₂: C, 72.26; H, 4.55; N, 6.02%. Found: C, 72.14; H, 4.47; N, 6.14%.

¹H NMR spectrum of 1-(4-bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1H-imidazole (**II**) in CDCl₃

¹³C NMR spectrum of 1-(4-bromophenyl)-4,5-diphenyl-2-*p*-tolyl-1H-imidazole (**II**) in CDCl₃

General procedure for bromination of imidazole derivatives

Synthesis of bromo-methyl imidazoles **2a–2d**

Compounds **2a–2d** were prepared by reacting compounds **1a–1d** (1 mmol) with *N*-bromosuccinimide (NBS) (1 mmol) in 70 mL of carbon tetrachloride under argon atmosphere. To initiate the reaction, 10 mol % of α,α' -azobisisobutyronitrile (AIBN) was added and the reaction mixture was stirred at 50–52 °C. The optimum reaction time for **2a–2d** was observed to be 2 days. Then the reaction mixture was cooled to 10 °C, and the precipitated succinimide was filtered off. The solution was washed with water three times, the organic phase dried over Na₂SO₄, and the solvent evaporated under vacuum. For example, crude products **2a** and **2b** were purified by column chromatography (silica gel, hexane/ethylacetate mixture (10:1, v/v)) to afford bromo-methyl imidazoles **2a** and **2b**.

2-(4-(Bromomethyl)phenyl)-1,4,5-triphenyl-1H-imidazole (2a)

White powder (75%), mp 160–162 °C, IR (KBr, cm⁻¹): $\nu_{\max}$ = 3058 (Ar–H), 2922 (C–H), 1600, 1495, 1446 (C=C), 1384, 1228, 764, 736, 697, 534. ¹H NMR (CDCl₃, 400 MHz) δ_{H} : 4.45 (s, 2H, CH₂–Br), 7.04–7.06 (m, 2H, Ar–H), 7.11–7.13 (m, 2H, Ar–H), 7.18–7.33 (m, 11H, Ar–H), 7.41 (d, *J* 8.2 Hz, 2H, Ar–H), 7.58 (d, *J* 7.2 Hz, 2H, Ar–H). ¹³C NMR (CDCl₃, 100 MHz) δ_{C} : 32.11 (CH₂–Br), 125.65, 126.34, 126.40, 127.00, 127.15, 127.27, 127.32, 127.36, 127.41, 127.79, 127.83, 128.00, 128.07, 128.16, 130.05, 135.94, 136.52, 145.10 (Ar). Anal.Calc. for C₂₈H₂₁BrN₂: C, 72.26; H, 4.55; N, 6.02%. Found: C, 72.13; H, 4.59; N, 6.24%.

¹H NMR spectrum of 2-(4-(bromomethyl)phenyl)-1,4,5-triphenyl-1H-imidazole (**2a**) in CDCl₃

¹³C NMR spectrum of 2-(4-(bromomethyl)phenyl)-1,4,5-triphenyl-1H-imidazole (**2a**) in CDCl₃

2-(4-(Bromomethyl)phenyl)-1-(4-fluorophenyl)-4,5-diphenyl-1*H*-imidazole (2b)

White powder (73%), mp 152–154 °C, IR (KBr, cm^{-1}): ν_{max} = 3058 (Ar–H), 2924 (C–H), 1603, 1509, 1446 (C=C), 1225, 825, 777, 733, 698, 532. ^1H NMR (CDCl_3 , 400 MHz) δ_{H} : 4.49 (s, 2H, $\text{CH}_2\text{--Br}$), 6.99–7.09 (m, 4H, Ar–H), 7.16 (dd, $J = 1.6$ Hz, $J = 7.8$ Hz, 2H, Ar–H), 7.24–7.34 (m, 8H, Ar–H), 7.44 (d, $J = 8.3$ Hz, 2H, Ar–H), 7.60–7.63 (m, 2H, Ar–H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : 31.98 ($\text{CH}_2\text{--Br}$), 115.165, 115.39, 125.77, 126.32, 127.19, 127.48, 127.94, 128.01, 128.12, 128.99, 129.07, 129.22, 130.05, 131.95, 133.03, 136.78, 159.75, 162.23 (Ar). Anal. Calc. for $\text{C}_{28}\text{H}_{20}\text{BrFN}_2$: C, 69.57; H, 4.17; N, 5.80%. Found: C, 69.45; H, 4.09; N, 5.72%.

¹H NMR spectrum of 2-(4-(bromomethyl)phenyl)-1-(4-fluorophenyl)-4,5-diphenyl-1*H*-imidazole (**2b**) in CDCl₃

¹³C NMR spectrum of 2-(4-(bromomethyl)phenyl)-1-(4-fluorophenyl)-4,5-diphenyl-1*H*-imidazole (**2b**)

Synthesis of bromopropoxy-imidazoles 2f and 2g

A mixture of (1 mmol) imidazole derivative (**1f** or **1g**) and (1 mmol) 1,3-dibromopropane in presence of K_2CO_3 in 100 mL of dry DMF was stirred at room temperature for 24 h. Then DMF solvent was evaporated in vacuum, and the residue was taken up in CH_2Cl_2 (50 mL) and the extract was washed with brine (30 mL) and then dried (Na_2SO_4). After filtration, the solvent evaporated, and the residue was purified by silica gel column chromatography using hexane/ethylacetate (75:25, v/v). Fraction containing bromopropoxy-imidazole was collected then the solvent was removed under reduced pressure.

Spectral data of some novel representative products are given below:

1-(4-(3-bromopropoxy)phenyl)-2-(4-chlorophenyl)-4,5-diphenyl-1H-imidazole (2f)

Yellow powder (64%), mp 175–177 °C, IR (KBr, cm^{-1}): ν_{max} = 3059 (Ar-H), 2925 (C-H), 1637, 1510, 1468 (C=C), 1239, 1169, 1090, 930, 694. 1H NMR ($CDCl_3$, 400 MHz) δ_H : 2.02–2.09 (m, 2H, $CH_2-CH_2-CH_2$), 3.48 (t, J = 6.5 Hz, 2H, CH_2-Br), 3.94 (t, J = 6.0 Hz, 2H, O- CH_2), 6.73–6.76 (m, 2H, Ar-H), 6.91–6.95 (m, 2H, Ar-H), 7.11–7.14 (m, 2H, Ar-H), 7.16–7.26 (m, 8H, Ar-H), 7.36–7.39 (m, 2H, Ar-H), 7.55–7.57 (m, 2H, Ar-H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ_C : 28.35 ($CH_2-CH_2-CH_2$), 31.36 (CH_2-Br), 65.97 (O- CH_2), 113.73, 125.54, 125.63, 126.29, 126.97, 127.16, 127.34, 127.36, 128.05, 128.34, 128.57, 129.01, 129.47, 130.05, 130.30, 133.16, 133.28, 137.24, 144.84, 157.49 (Ar). Anal.Calc. for $C_{30}H_{24}BrClN_2O$: C, 66.25; H, 4.45; N, 5.15%. Found: C, 66.33; H, 4.38; N, 5.31%.

¹H NMR spectrum of 1-(4-(3-bromopropoxy)phenyl)-2-(4-chlorophenyl)-4,5-diphenyl-1H-imidazole (2f) in CDCl₃

¹³C NMR spectrum of 1-(4-(3-bromopropoxy)phenyl)-2-(4-chlorophenyl)-4,5-diphenyl-1H-imidazole (2f)

1-(4-(3-bromopropoxy)phenyl)-4,5-diphenyl-2-p-tolyl-1*H*-imidazole (2g)

White powder (60%), mp 160-162 °C. IR (KBr, cm^{-1}): ν_{max} = 3056 (Ar-H), 2924 (C-H), 1605, 1577, 1513, 1465 (C=C), 1245, 1175, 1108, 1026, 698. ^1H NMR (CDCl_3 , 400 MHz) δ_{H} : 2.30-2.35 (m, 5H, $\text{CH}_2\text{-CH}_2\text{-CH}_2$ and CH_3), 3.62 (t, J 6.4 Hz, 2H, $\text{CH}_2\text{-Br}$), 4.11 (t, J 5.8 Hz, 2H, O-CH_2), 6.81 (d, J = 8.6 Hz, 2H, Ar-H), 6.95 (d, J = 8.0 Hz, 2H, Ar-H), 7.09 (d, J = 7.9 Hz, 2H, Ar-H), 7.15-7.30 (m, 8H, Ar-H), 7.40 (d, J = 8.6 Hz, 2H, Ar-H), 7.62 (d, J = 7.3 Hz, 2H, Ar-H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : 20.15 (CH_3), 28.93 ($\text{CH}_2\text{-CH}_2\text{-CH}_2$), 31.30 ($\text{CH}_2\text{-Br}$), 64.20 (O-CH_2), 113.05, 122.46, 125.46, 126.37, 126.53, 126.78, 127.09, 127.13, 127.26, 128.19, 128.67, 129.30, 129.55, 129.82, 130.12, 133.54, 136.90, 137.07, 145.82, 157.61 (Ar). Anal.Calc. for $\text{C}_{31}\text{H}_{27}\text{BrN}_2\text{O}$: C, 71.13; H, 5.20; N, 5.35%. Found: C, 70.98; H, 5.04; N, 5.24%.

¹H NMR spectrum of 1-(4-(3-bromopropoxy)phenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (**2g**) in CDCl₃

¹³C NMR spectrum of 1-(4-(3-bromopropoxy)phenyl)-4,5-diphenyl-2-*p*-tolyl-1*H*-imidazole (**2g**) in CDCl₃

1-Mercapto-1,1-bis(trimethylsilyl)-3-(4-(1,4,5-triphenyl-1*H*-imidazol-2-yl)phenyl)propane-2-thione (3a)

A yellow sticky solid (94%), IR (KBr, cm^{-1}): ν_{max} = 3058 (Ar-H), 2951 (C-H), 1624, 1600, 1494, 1419 (C=C), 1408, 1148 (C=S), 1250, 915, 850 (C-Si), 1027 (C-S). ^1H NMR (CDCl_3 , 400 MHz) 0.15 (s, 18H, SiMe_3), 3.10 (bs, 1H, S-H), 4.40 (s, 2H, CH_2), 7.02 (dd, J = 1.4 Hz, J = 8.0 Hz, 2H, Ar-H), 7.12 (dd, J = 1.6 Hz, J = 7.8 Hz, 2H, Ar-H), 7.17–7.28 (m, 11H, Ar-H), 7.34 (d, J = 8.2 Hz, 2H, Ar-H), 7.59 (dd, J = 1.6 Hz, J = 8.2 Hz, 2H, Ar-H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : -1.17 (SiMe_3), 40.56 (CH_2), 54.93 ($\text{C}(\text{SiMe}_3)_2\text{SH}$), 125.58, 126.22, 126.36, 126.92, 127.12, 127.25, 127.30, 127.37, 127.51, 127.79, 127.87, 127.94, 128.06, 129.56, 130.07, 135.54, 136.01, 145.52 (Ar), 214.02 (C=S). Anal. Calc. for $\text{C}_{36}\text{H}_{40}\text{N}_2\text{S}_2\text{Si}_2$: C, 69.63; H, 6.49; N, 4.51%. Found: C, 69.57; H, 6.30; N, 4.39%.

¹H NMR spectrum of 1-Mercapto-1,1-bis(trimethylsilyl)-3-(4-(1,4,5-triphenyl-1*H*-imidazol-2-yl)phenyl)propane-2-thione (**3a**) in CDCl₃

¹³C NMR spectrum of 1-Mercapto-1,1-bis(trimethylsilyl)-3-(4-(1,4,5-triphenyl-1*H*-imidazol-2-yl)phenyl)propane-2-thione (**3a**) in CDCl₃

3-(4-(1-(4-Fluorophenyl)-4,5-diphenyl-1*H*-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (3b)

A yellow sticky solid (96%), IR (KBr, cm^{-1}): ν_{max} = 3060 (Ar-H), 2955 (C-H), 1605, 1561, 1508, 1482, 1447 (C=C), 1409, 1151 (C=S), 1253, 916, 855 (C-Si), 1028 (C-S). ^1H NMR (CDCl_3 , 400 MHz) δ_{H} : 0.18 (s, 18H, SiMe_3), 3.14 (bs, 1H, S-H), 4.45 (s, 2H, CH_2), 6.94–7.00 (m, 4H, Ar-H), 7.11 (d, J = 6.8 Hz, 2H, Ar-H), 7.13–7.28 (m, 10H, Ar-H), 7.61 (d, J = 7.1 Hz, 2H, Ar-H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : -1.18 (SiMe_3), 41.27 (CH_2), 55.40 ($\text{C}(\text{SiMe}_3)_2\text{SH}$), 115.04, 115.27, 126.33, 127.17, 127.31, 127.46, 127.59, 127.77, 127.84, 127.89, 127.96, 127.98, 128.95, 129.04, 129.96, 130.05, 130.25, 132.00, 137.56, 146.28, 159.66, 162.13 (Ar), 214.28 (C=S). Anal. Calc. for $\text{C}_{36}\text{H}_{39}\text{FN}_2\text{S}_2\text{Si}_2$: C, 67.67; H, 6.15; N, 4.38%. Found: C, 67.44; H, 6.29; N, 4.53%.

¹H NMR spectrum of 3-(4-(1-(4-fluorophenyl)-4,5-diphenyl-1H-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (**3b**) in CDCl₃

¹³C NMR spectrum of 3-(4-(1-(4-fluorophenyl)-4,5-diphenyl-1H-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (**3b**) in CDCl₃

3-(4-(1-(4-Chlorophenyl)-4,5-diphenyl-1*H*-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (3c)

A yellow sticky solid (96%), IR (KBr, cm^{-1}): ν_{max} = 3059 (Ar-H), 2956 (C-H), 1604, 1560, 1504, 1480, 1444 (C=C), 1410, 1150 (C=S), 1252, 919, 854 (C-Si), 1027 (C-S). ^1H NMR (CDCl_3 , 400 MHz) 0.18 (s, 18H, SiMe_3), 3.15 (bs, 1H, S-H), 4.45 (s, 2H, CH_2), 6.98 (d, J = 8.4 Hz, 2H, Ar-H), 7.14 (dd, J = 1.5 Hz, J = 7.7 Hz, 2H, Ar-H), 7.24–7.31 (m, 10H, Ar-H), 7.37 (d, J = 8.4 Hz, 2H, Ar-H), 7.60 (dd, J = 1.5 Hz, J = 7.7 Hz, 2H, Ar-H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : -1.16 (SiMe_3), 40.48 (CH_2), 54.48 ($\text{C}(\text{SiMe}_3)_2\text{SH}$), 125.70, 126.45, 127.15, 127.51, 127.77, 128.28, 128.64, 129.44, 130.09, 132.94, 133.27, 134.62, 137.47, 142.27, 146.04 (Ar), 214.60 (C=S). Anal. Calc. for $\text{C}_{36}\text{H}_{39}\text{ClN}_2\text{S}_2\text{Si}_2$: C, 65.97; H, 6.00; N, 4.27%. Found: C, 65.73; H, 6.32; N, 4.51%.

¹H NMR spectrum of 3-(4-(1-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (**3c**) in CDCl₃

¹³C NMR spectrum of 3-(4-(1-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (**3c**) in CDCl₃

3-(4-(1-(3-Chlorophenyl)-4,5-diphenyl-1*H*-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (3d)

A yellow sticky solid (93%), IR (KBr, cm^{-1}): ν_{max} = 3060 (Ar-H), 2956 (C-H), 1590, 1479, 1420 (C=C), 1409, 1148 (C=S), 1250, 917, 850 (C-Si), 1027 (C-S). ^1H NMR (CDCl_3 , 400 MHz) δ_{H} : 0.14 (s, 18H, SiMe_3), 3.10 (bs, 1H, S-H), 4.41 (s, 2H, CH_2), 6.90–6.92 (m, 1H, Ar-H), 7.03 (t, J = 1.9 Hz, 1H, Ar-H), 7.10–7.12 (m, 2H, Ar-H), 7.16–7.28 (m, 10H, Ar-H), 7.34 (d, J = 8.2 (Hz), 2H, Ar-H), 7.57 (dd, J = 1.3, J = 8.2, 2H, Ar-H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : -1.17 (SiMe_3), 40.49 (CH_2), 54.96 ($\text{C}(\text{SiMe}_3)_2\text{SH}$), 125.71, 125.74, 126.15, 126.33, 127.17, 127.25, 127.51, 127.58, 127.61, 127.95, 128.05, 128.99, 129.16, 130.04, 133.59, 135.98, 137.15, 145.50 (Ar), 213.49 (C=S).
Anal. Calc. for $\text{C}_{36}\text{H}_{39}\text{ClN}_2\text{S}_2\text{Si}_2$: C, 65.97; H, 6.00; N, 4.27%. Found: C, 65.81; H, 6.21; N, 4.08%.

¹H NMR spectrum of 3-(4-(1-(3-chlorophenyl)-4,5-diphenyl-1*H*-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (**3d**) in CDCl₃

¹³C NMR spectrum of 3-(4-(1-(3-chlorophenyl)-4,5-diphenyl-1*H*-imidazol-2-yl)phenyl)-1-mercapto-1,1-bis(trimethylsilyl)propane-2-thione (**3d**) in CDCl₃

5-(4-(2-(4-Chlorophenyl)-4,5-diphenyl-1*H*-imidazol-1-yl)phenoxy)-1-mercapto-1,1-bis(trimethylsilyl)pentane-2-thione (3f)

A yellow sticky solid (95%), IR (KBr, cm^{-1}): ν_{max} = 3060 (Ar-H), 2955 (C-H), 1592, 1481, 1423 (C=C), 1410, 1149 (C=S), 1251, 915, 852 (C-Si), 1029 (C-S). ^1H NMR (CDCl_3 , 400 MHz) δ_{H} : 0.19 (s, 18H, SiMe₃), 2.11–2.17 (m, 2H, CH₂–CH₂–CH₂), 3.17 (bs, 1H, S–H), 3.37 (t, J 7.1 Hz, 2H, (CH₂–C(SiMe₃)₂S), 4.01 (t, J = 6.10 Hz, 2H, O–CH₂), 6.80 (d, J = 7.9 Hz, 2H, Ar–H), 6.98 (d, J = 8.1 Hz, 2H, Ar–H), 7.16 (d, J = 6.2 Hz, 2H, Ar–H), 7.23–7.32 (m, 8H, Ar–H), 7.43 (d, J = 7.9 Hz, 2H, Ar–H), 7.61 (d, J = 7.4, 2H, Ar–H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : -1.18 (SiMe₃), 28.69 (CH₂), 38.43 (CH₂–C(SiMe₃)₂S), 54.09 (C(SiMe₃)₂SH), 65.35 (O–CH₂), 113.84, 125.68, 126.35, 126.82, 127.02, 127.18, 127.39, 128.36, 128.13, 128.77, 128.89, 129.09, 129.59, 129.63, 130.09, 133.42, 137.13, 145.79, 157.67 (Ar), 213.95 (C=S). Anal. Calc. for C₃₈H₄₃ClN₂OS₂Si₂: C, 65.25; H, 6.20; N, 4.00%. Found: C, 65.31; H, 6.41; N, 3.88%.

¹H NMR spectrum of 5-(4-(2-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazol-1-yl)phenoxy)-1-mercapto-1,1-bis(trimethylsilyl)pentane-2-thione (**3f**) in CDCl₃

¹³C NMR spectrum of 5-(4-(2-(4-chlorophenyl)-4,5-diphenyl-1*H*-imidazol-1-yl)phenoxy)-1-mercapto-1,1-bis(trimethylsilyl)pentane-2-thione (**3f**) in CDCl₃

**5-(4-(4,5-diphenyl-2-*p*-tolyl-1*H*-imidazol-1-yl)phenoxy)-1-mercapto-1,1-bis(trimethylsilyl)pentane-2-thione
(3g)**

A yellow sticky solid (94%), IR (KBr, cm^{-1}): ν_{max} = 3031 (Ar-H), 2948 (C-H), 1607, 1562, 1511, 1461, 1421 (C=C), 1407, 1147 (C=S), 1248, 920, 856 (C-Si), 1028 (C-S). ^1H NMR (CDCl_3 , 400 MHz) δ_{H} : 0.18 (s, 18H, SiMe_3), 2.12–2.19 (m, 2H, $\text{CH}_2\text{--CH}_2\text{--CH}_2$), 2.36 (s, 3H, CH_3), 3.19 (bs, 1H, S-H), 3.41 (t, J = 7.2 Hz, 2H, ($\text{CH}_2\text{--C}(\text{SiMe}_3)_2\text{S}$), 4.03 (t, J = 6.5 Hz, 2H, O- CH_2), 6.80 (d, J = 8.8 Hz, 2H, Ar-H), 6.95 (d, J = 8.1 Hz, 2H, Ar-H), 7.08 (d, J = 8.1 Hz, 2H, Ar-H), 7.15 (dd, J = 1.7 Hz, J = 7.2 Hz, 2H, Ar-H), 7.22–7.30 (m, 6H, Ar-H), 7.40 (dd, J = 2.9 Hz, J = 8.8 Hz, 2H, Ar-H), 7.61 (d, J = 7.2, 2H, Ar-H). ^{13}C NMR (CDCl_3 , 100 MHz) δ_{C} : -1.19 (SiMe_3), 20.18 (CH_3), 28.68 (CH_2), 38.29 ($\text{CH}_2\text{--C}(\text{SiMe}_3)_2\text{S}$), 55.20 ($\text{C}(\text{SiMe}_3)_2\text{SH}$), 65.33 (O- CH_2), 113.00, 125.51, 126.40, 126.81, 127.08, 127.11, 127.27, 128.01, 128.10, 128.69, 128.89, 129.33, 129.50, 129.65, 130.08, 133.40, 137.10, 145.77, 157.64 (Ar), 214.60 (C=S). Anal. Calc. for $\text{C}_{39}\text{H}_{46}\text{N}_2\text{OS}_2\text{Si}_2$: C, 68.98; H, 6.83; N, 4.13%. Found: C, 68.79; H, 6.91; N, 4.27%.

¹H NMR spectrum of 5-(4-(4,5-diphenyl-2-p-tolyl-1H-imidazol-1-yl)phenoxy)-1-mercapto-1,1-bis(trimethylsilyl)pentane-2-thione (**3g**) in CDCl₃

¹³C NMR spectrum of 5-(4-(4,5-diphenyl-2-p-tolyl-1H-imidazol-1-yl)phenoxy)-1-mercapto-1,1-bis(trimethylsilyl)pentane-2-thione (**3g**) in CDCl₃

SEM images of $\text{La}_{0.8}\text{Sr}_{0.2}\text{Fe}_{0.34}\text{Co}_{0.66}\text{O}_3$