Supporting Information

Sb(III)/Gum Arabic composite as a new natural-based environmentally green catalyst for the one-pot pseudo-four-component synthesis of 2*H*-Indazolo[2,1-*b*] phthalazinetriones

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Section S1. IR, and ^{1}H NMR spectra of products

3,4-Dihydro-3,3-dimethyl-13-(4-carboxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) ῡ (cm^{-1}): 3401, 3213, 2956, 1691, 1528, 1379, 1237, 1156, 1086, 699. ^{1}H NMR (DMSO-d_6, 400MHz) /δ ppm: 1.09 (s, CH_3), 1.12 (s, CH_3), 2.25 (s, CH_2), 3.20 (q, CH_2), 6.46 (s. CH), 7.60 (t, 1H, *J* = 8 Hz), 7.87 (d, 2CH, *J* = 8.4 Hz), 7.95 (t, 2CH, *J* = 8 Hz), 8.12 (d, 1H, *J* = 8.4 Hz), 8.26 (d, 1H, *J* = 8.4 Hz), 8.35 (s, CH). 12.04 (s, 1H, OH acid).

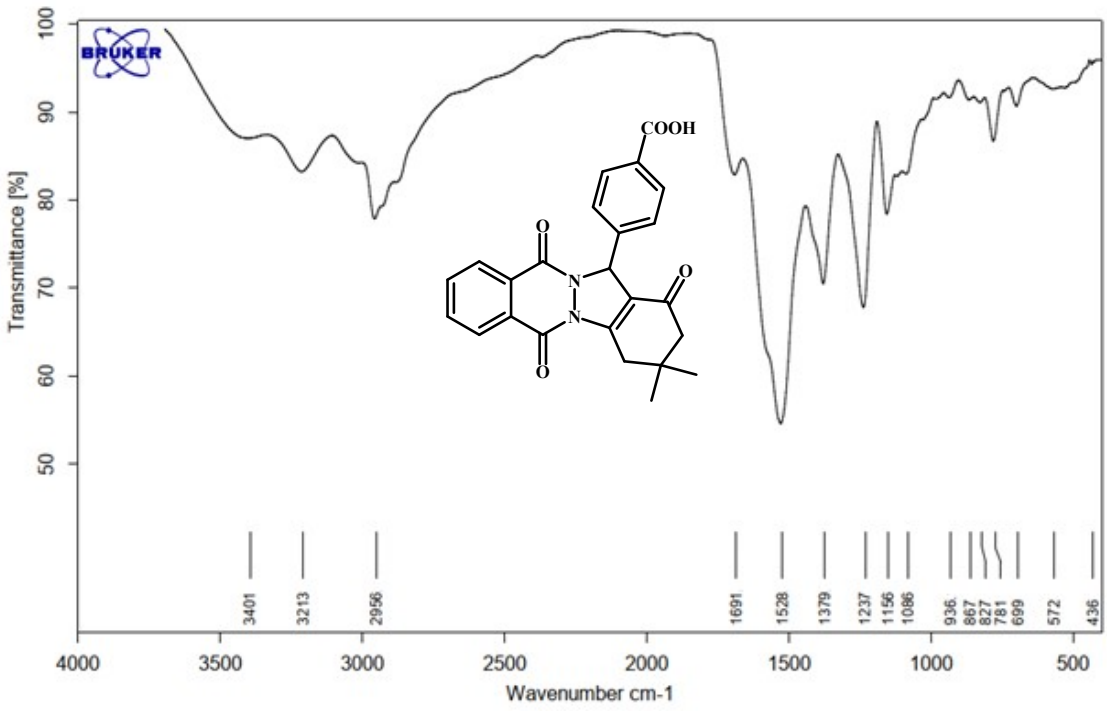

Figure S1: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-carboxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

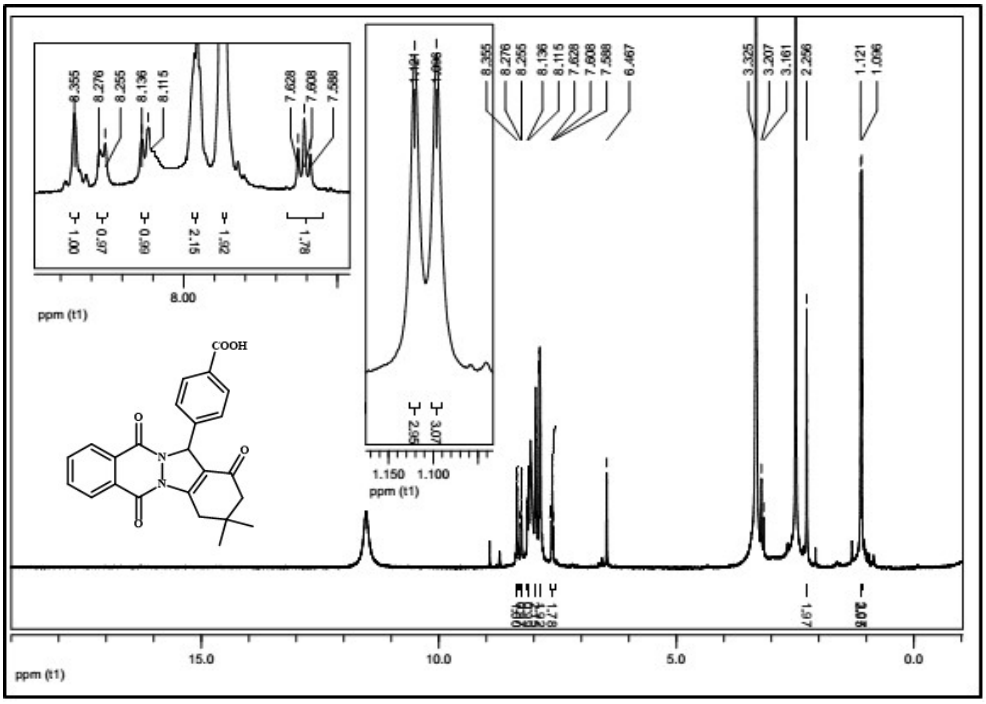

Figure S2: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-carboxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(4-chlorophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) $\bar{\upsilon}$ (cm^{-1}): 2958, 2924, 1662, 1585, 1490, 1365, 1221, 826. ^{1}H NMR (DMSO-d_6, 400MHz /δ ppm): 1.07 (s, CH_3), 1.10(s, CH_3), 2.24 (s, CH_2), 3.21 (q, CH_2), 6.27 (s. CH), 7.34 (d, 1H, J = 8.4 Hz), 7.47 (d, 2CH, J = 8.4 Hz), 7.95 (t, 2CH, J = 7.6 Hz), 8.06 (d, 1H, J = 7.4 Hz), 8.24 (d, 1H, J = 7.4 Hz).

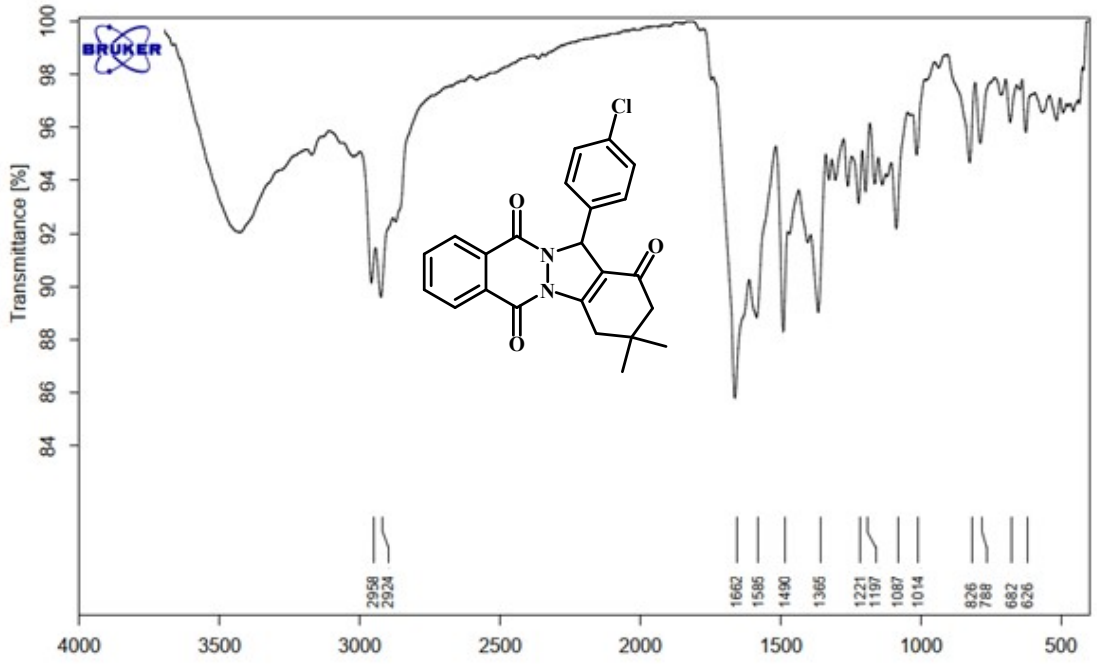

Figure S3: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-chlorophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

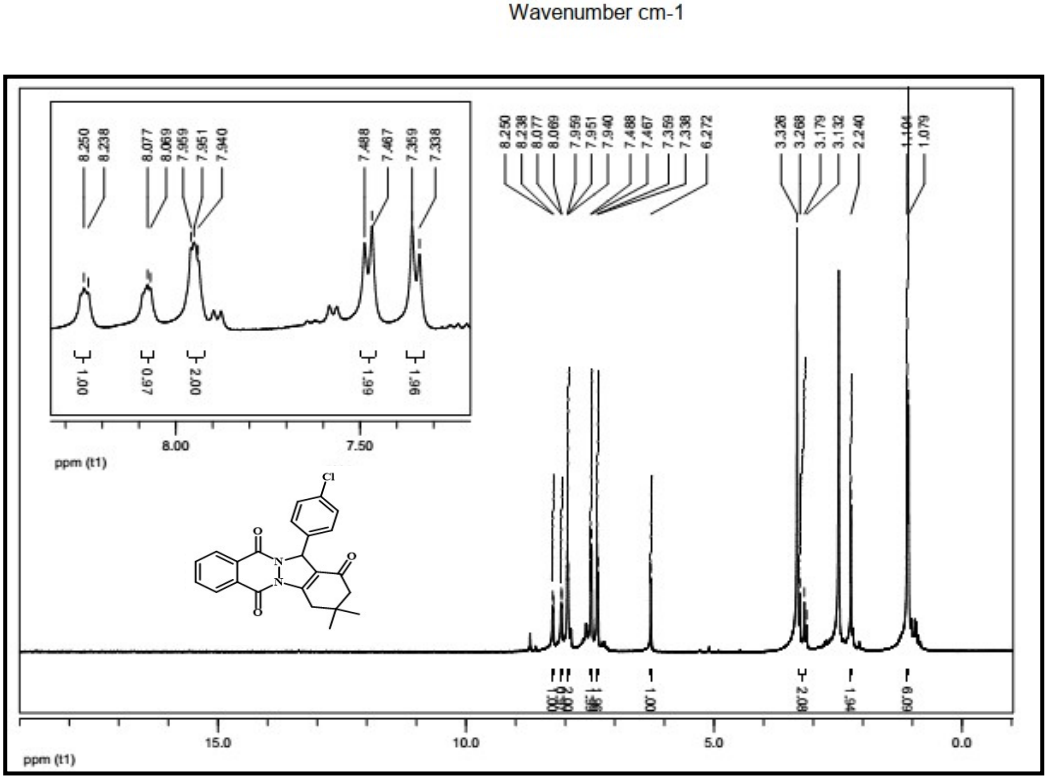

Figure S4: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-chlorophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(3-chlorophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) ῡ (cm^{-1}): 2957, 2871, 1633, 1593, 1469, 1366, 1227, 887, 755, 670. ^{1}H NMR (DMSO-d_6, 400MHz /δ ppm): 1.09 (s, CH_3), 1.12 (s, CH_3), 2.25 (s, CH), 3.22 (q, CH_2), 6.46 (s. CH), 7.61 (t, 2H, *J* = 8 Hz), 7.95 (d, 2H, *J* = 8.4 Hz), 8.07 (t, 1H, *J* = 8), 8.12 (d, 1H, *J* = 8.4 Hz), 8.26 (d, 1H, *J* = 8.4 Hz), 8.36 (s, 1H).

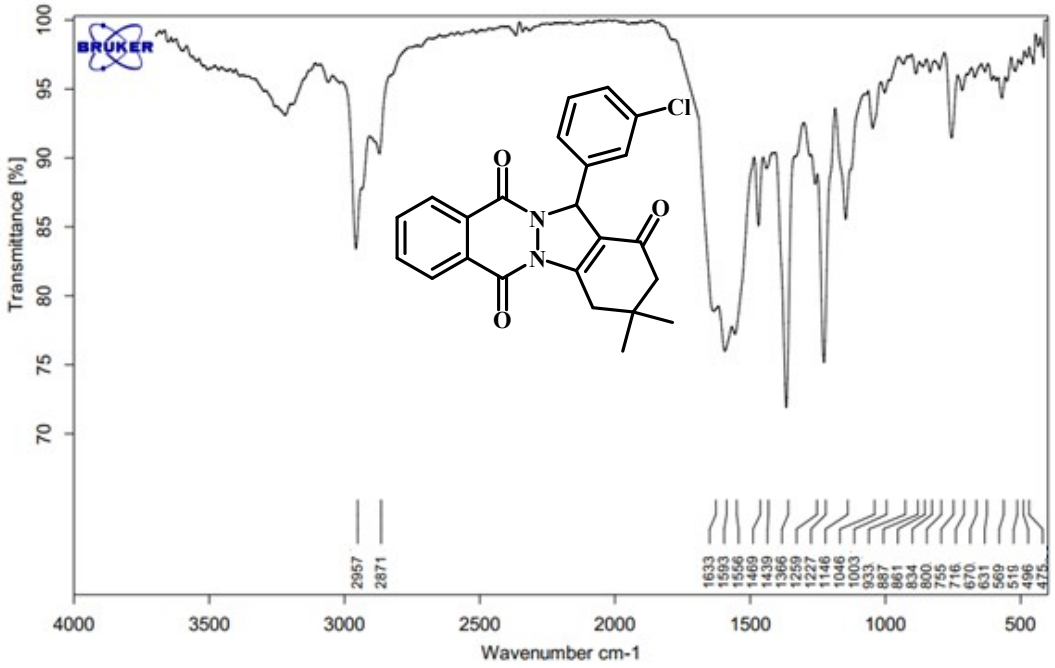

Figure S5: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(3-chlorophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

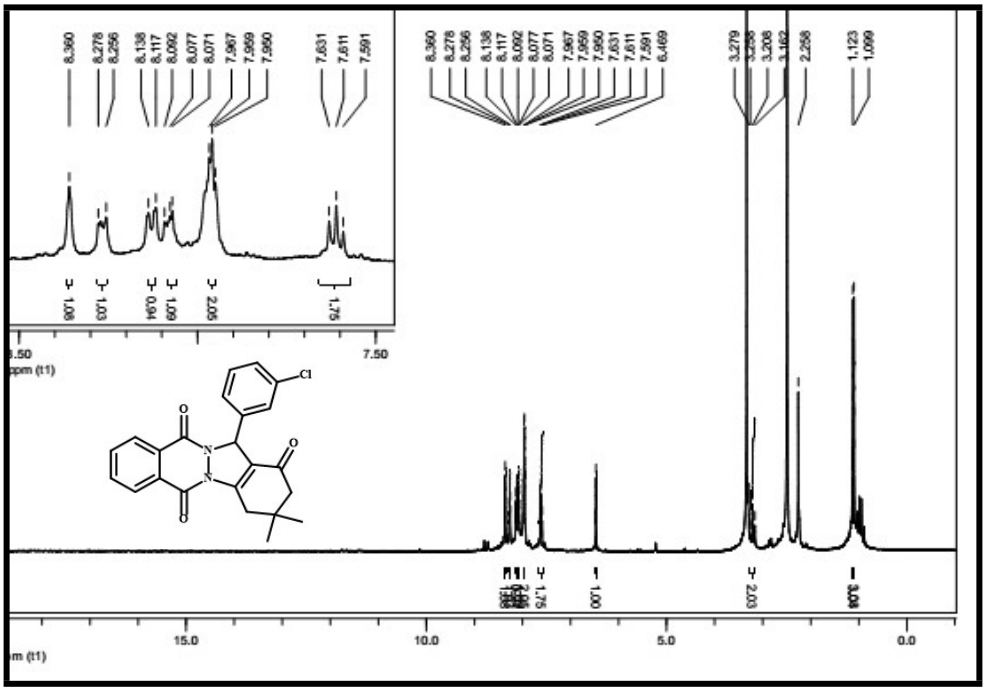

Figure S6: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(3-chlorophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(4-hydroxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) $\bar{\upsilon}$ (cm^{-1}): 3384, 2960, 1651, 1617, 1451, 1363, 1198, 875. ^{1}H NMR (DMSO-d_6, 400MHz /δ ppm): 1.10 (s, CH_3), 1.11 (s, CH_3), 2.24 (s, CH_2), 3.22 (q, CH_2), 3.36 (s, OH), 6.22 (s. CH), 6.84 (d, 2H, *J* = 8.4 Hz), 7.33 (d, 2CH, *J* = 8.4 Hz), 7.93 (t, 2CH, *J* = 7.6 Hz), 8.07 (d, 1H, *J* = 7.2 Hz), 8.23 (d, 1H, *J* = 7.2 Hz).

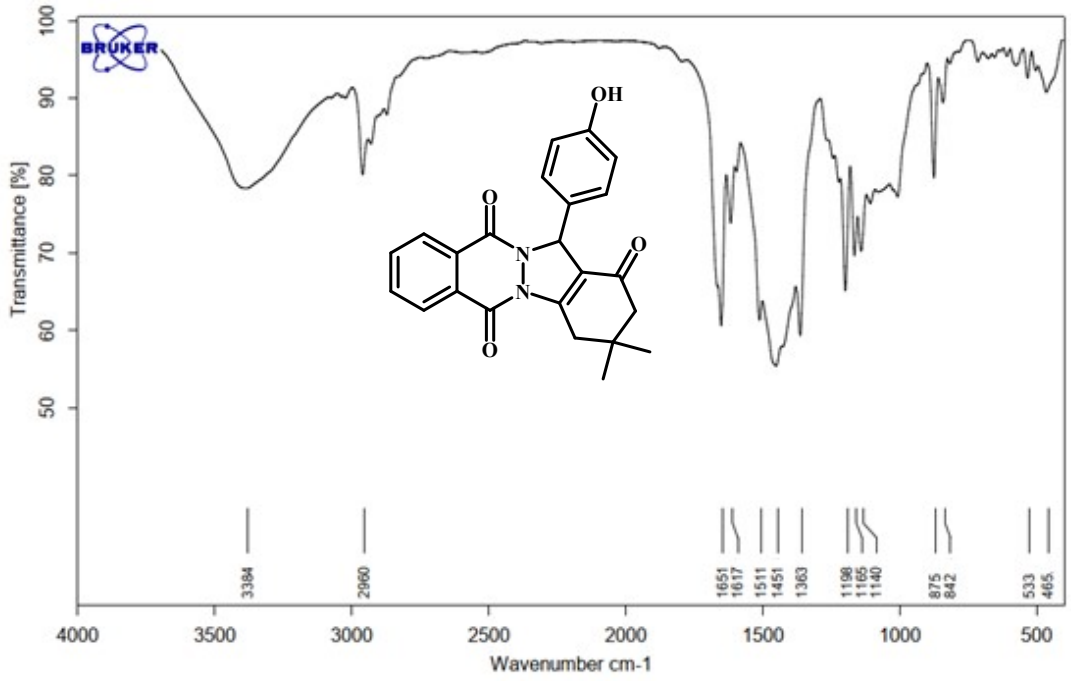

Figure S7: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-hydroxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

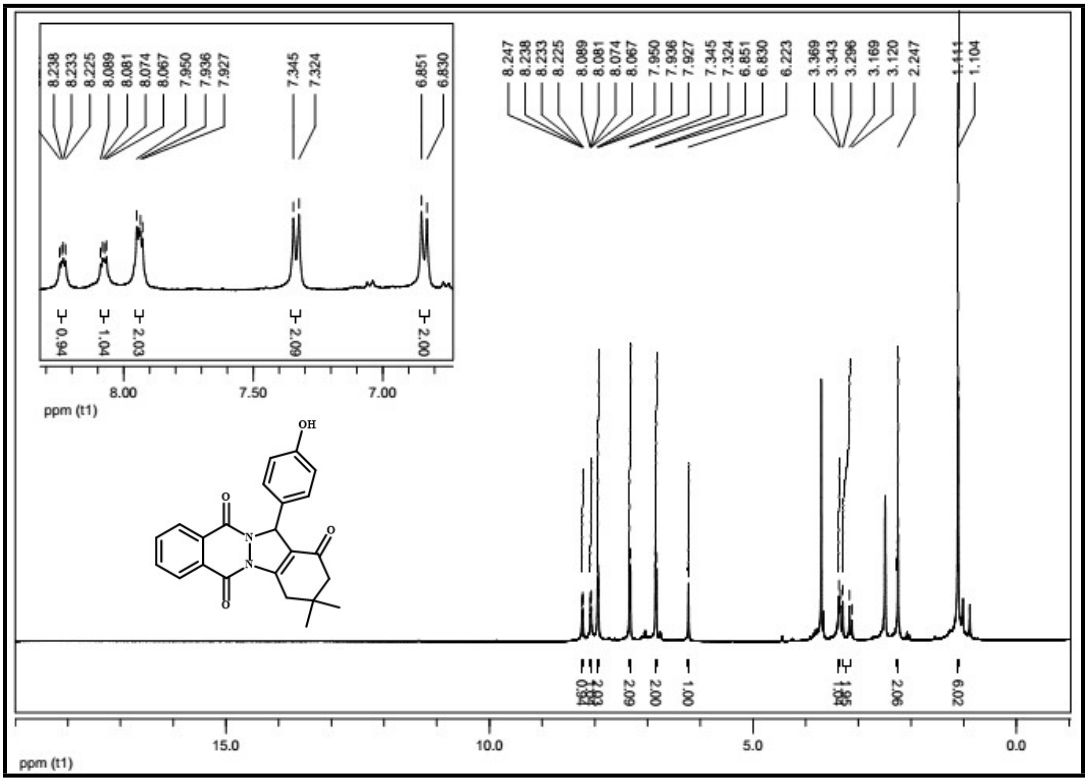

Figure S8: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-hydroxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(3-nitrophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) $\bar{\upsilon}$ (cm^{-1}): 2958, 1669, 1585, 1530, 1468, 1397, 1350, 1235, 807, 734, 673. ^{1}H NMR (DMSO-d_6, 400MHz /δ ppm): 1.06 (s, CH_3), 1.13 (s, CH_3), 2.52 (s, CH_2), 3.34 (q, CH_2), 5.79 (s. CH), 7.59 (s, 1H), 7.66 (d, 1CH, *J* = 8.4 Hz), 7.93-8.03(m, 4H, Ph), 8.22 (s, 1H), 8.26 (d, CH, *J* = 8.4 Hz).

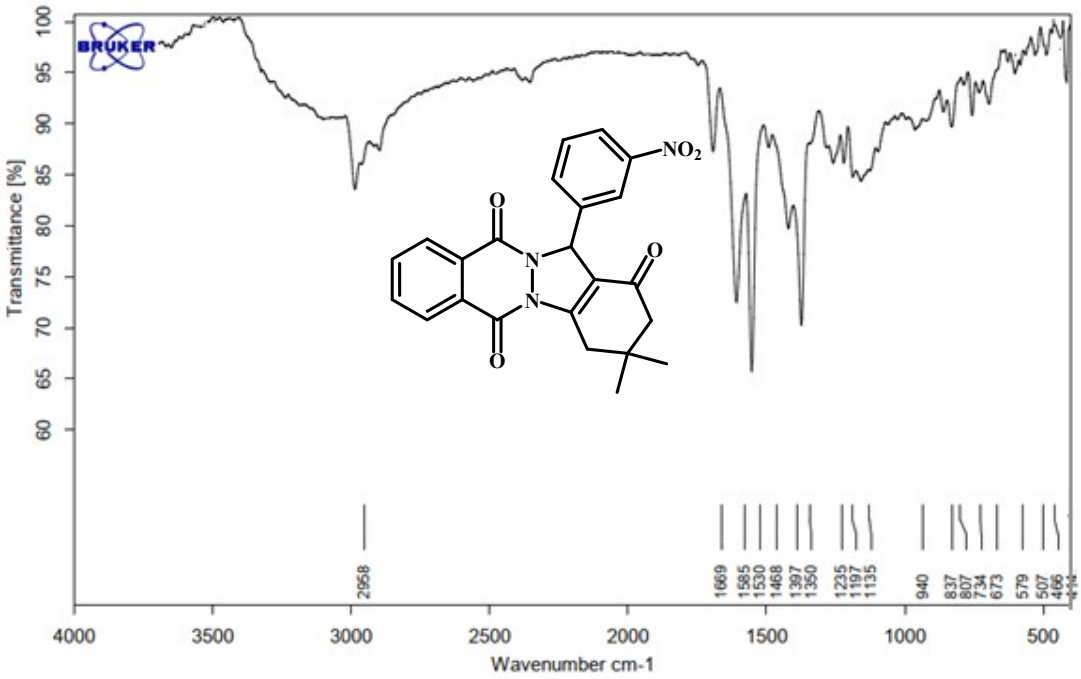

Figure S9: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(3-nitrophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

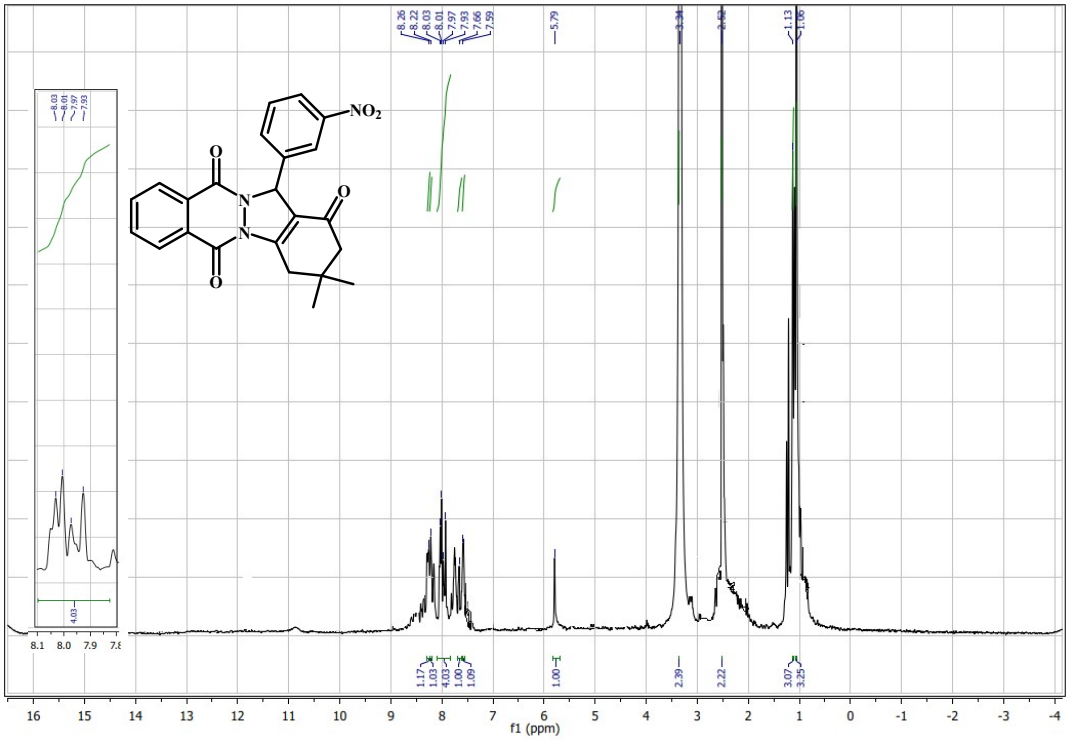

Figure S10: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(3-nitrophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(4-methylphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) $\bar{\upsilon}$ (cm^{-1}): 2958, 1664, 1626, 1450, 1359, 1197, 1165, 818. ^{1}H NMR (DMSO-d$_6$, 400MHz /δ ppm): 1.08 (s, CH_3), 1.11 (s, CH_3), 2.49 (s, CH_2), 3.29 (q, CH_2), 6.22 (s. CH), 7.09 (d, 2H, J = 8 Hz), 7.29 (d, 2CH, J = 8.4 Hz), 7.94 (t, 2CH, J = 8 Hz), 8.07 (d, 1H, J = 8.4 Hz), 8.24 (d, 1H, J = 8.4 Hz), 8.35 (s, CH).

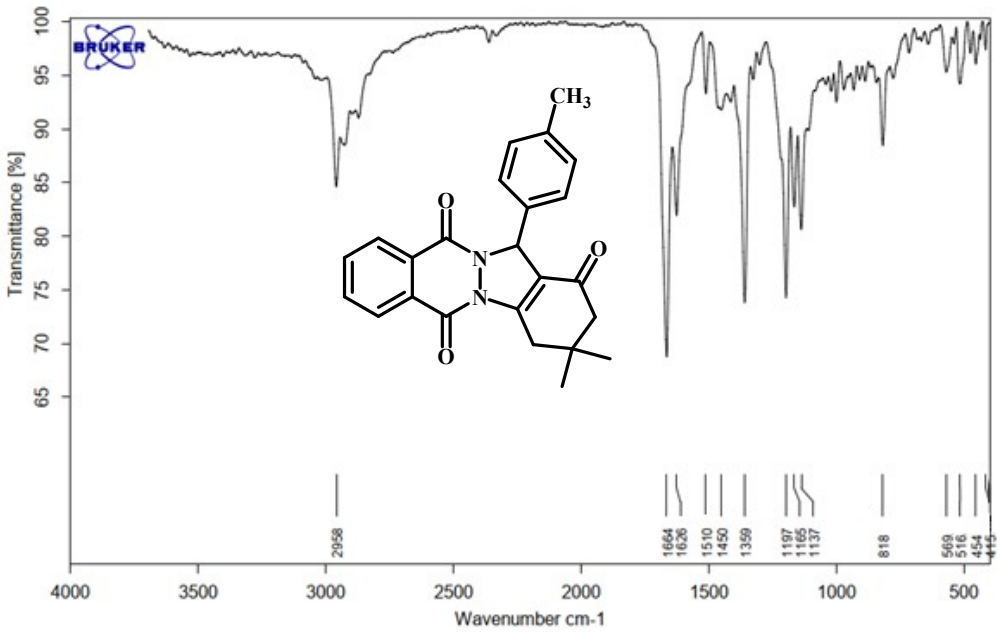

Figure S11: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-methylphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

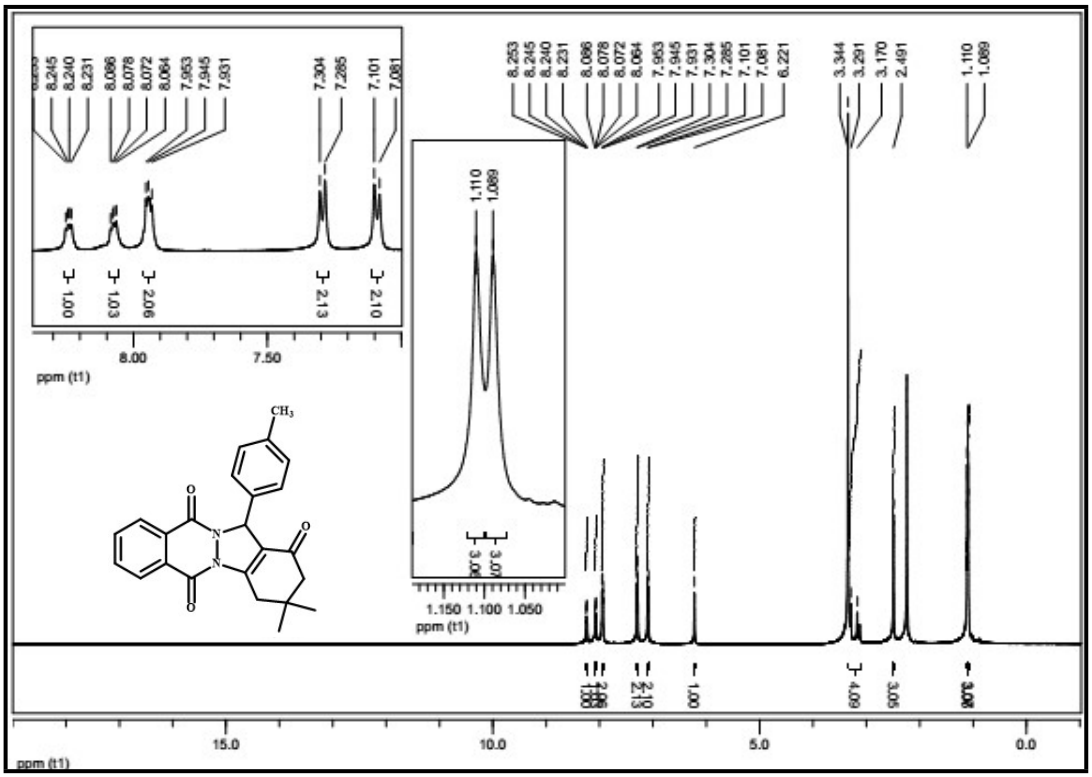

Figure S12: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-methylphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(4-methoxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) $\bar{\upsilon}$ (cm^{-1}): 2959, 2838, 1664, 1602, 1509, 1463, 1359, 1322, 1253, 1166, 1026, 834. ^{1}H NMR (DMSO-d_6, 400MHz /δ ppm): 1.08 (s, CH_3), 1.11 (s, CH_3), 2.24 (s, CH_2), 3.23 (q, CH_2), 4.23 (s, CH_3), 6.22 (s. CH), 7.09 (d, 2H, J = 8 Hz), 7.29 (d, 2CH, J = 8 Hz), 7.94 (t, 2CH, J = 8.4 Hz), 8.07 (d, 1H, J = 7.6 Hz), 8.24 (d, 1H, J = 7.6 Hz).

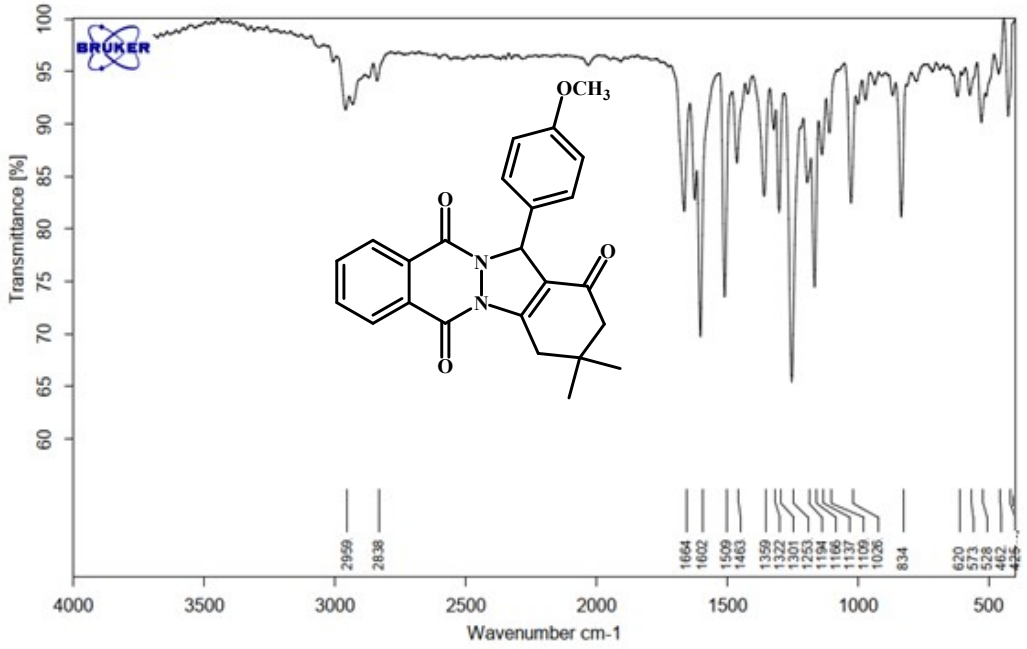

Figure S13: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-methoxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

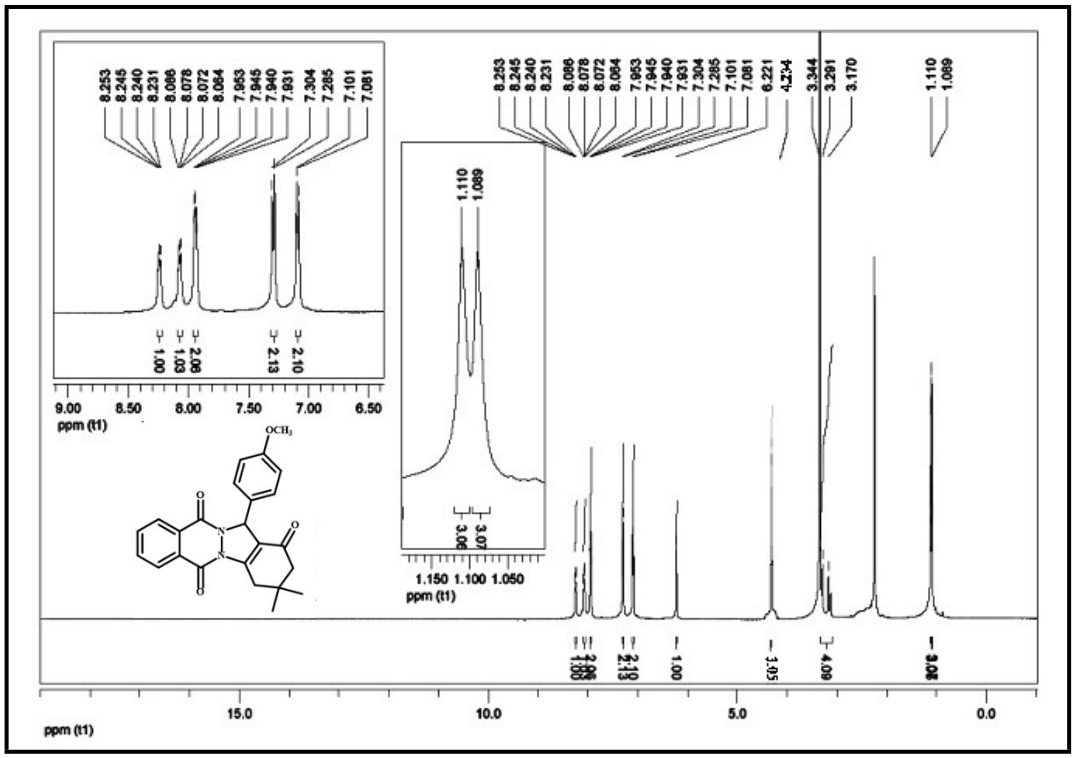

Figure S14: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-methoxyphenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(2-hydroxy-5-bromophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) ῡ (cm^{-1}): 3381, 2955, 1635, 1574, 1478, 1381, 1237, 1182, 839, 782, 693. ^1H NMR (DMSO-d_6, 400MHz /δ ppm): 0.99 (s, CH_3), 1.12 (s, CH_3), 1.23 (s, CH), 2.21 (q, CH_2), 2.46 (s, CH_2), 4.71 (s. OH), 5.49 (s, CH), 7.19 (t, 2H, *J* = 8 Hz), 7.23 (d, 2H, *J* = 8.4 Hz), 7.26 (s, 1H), 7.86 (d, 1H, *J* = 8.4 Hz), 7.99 (d, 1H, *J* = 8.4 Hz).

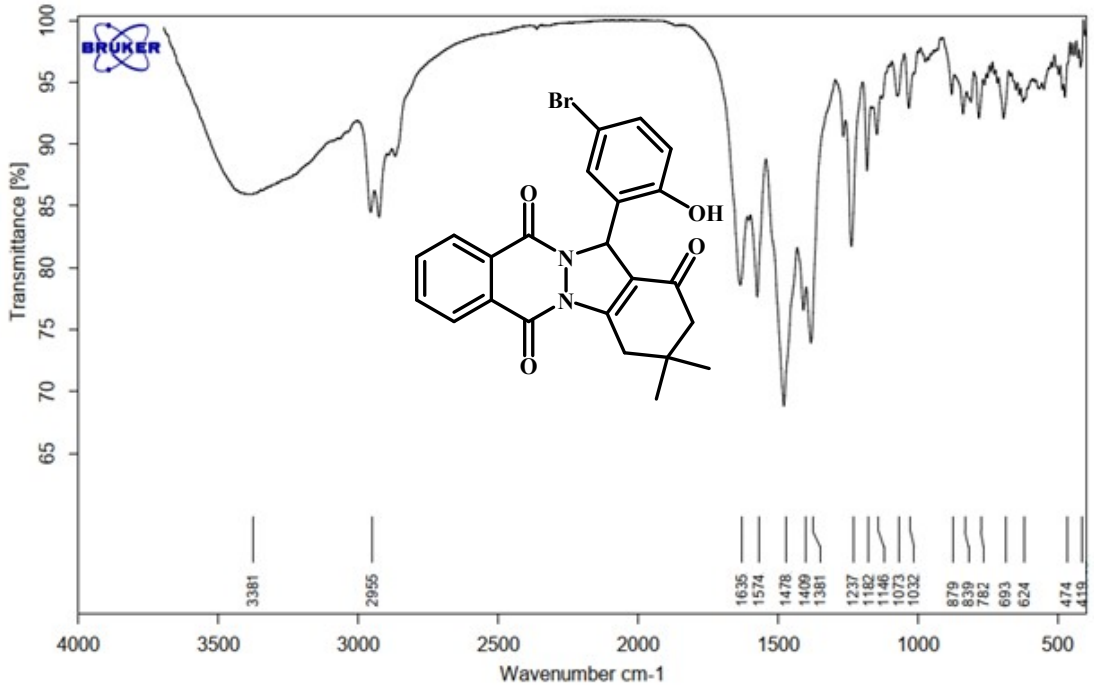

Figure S15: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(2-hydroxy-5-bromophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

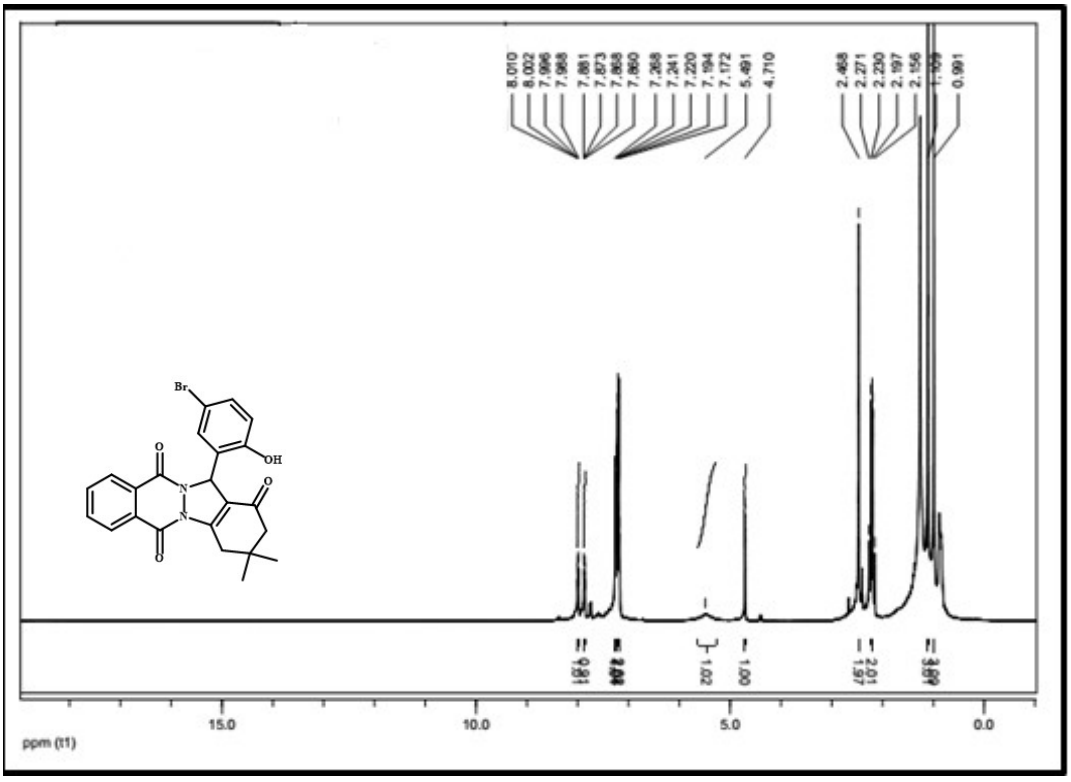

Figure S16: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(2-hydroxy-5-bromophenyl)-2*H*-indazolo[2,1-*b*] phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(4-nitrophenyl)-2*H*-indazolo[2,1-*b*]phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) $\bar{\upsilon}$ (cm^{-1}): 2961, 1659, 1598, 1519, 1466, 1388, 1344, 1203, 744. ^{1}H NMR (DMSO-d$_6$, 400MHz /δ ppm): 1.08 (s, CH_3), 1.12 (s, CH_3), 2.23 (q, CH_2), 3.24 (q, CH_2), 6.61 (s. CH), 7.26 (t, 2H, *J* = 8 Hz), 7.38 (d, 1H, *J* = 8.4 Hz), 7.51(d, 1H, *J* = 8.4 Hz), 7.96 (t, 2H, *J* = 7.2 Hz), 8.06 (d, 1H, *J* = 7.6 Hz), 8.25 (d, 1H, *J* =7.2).

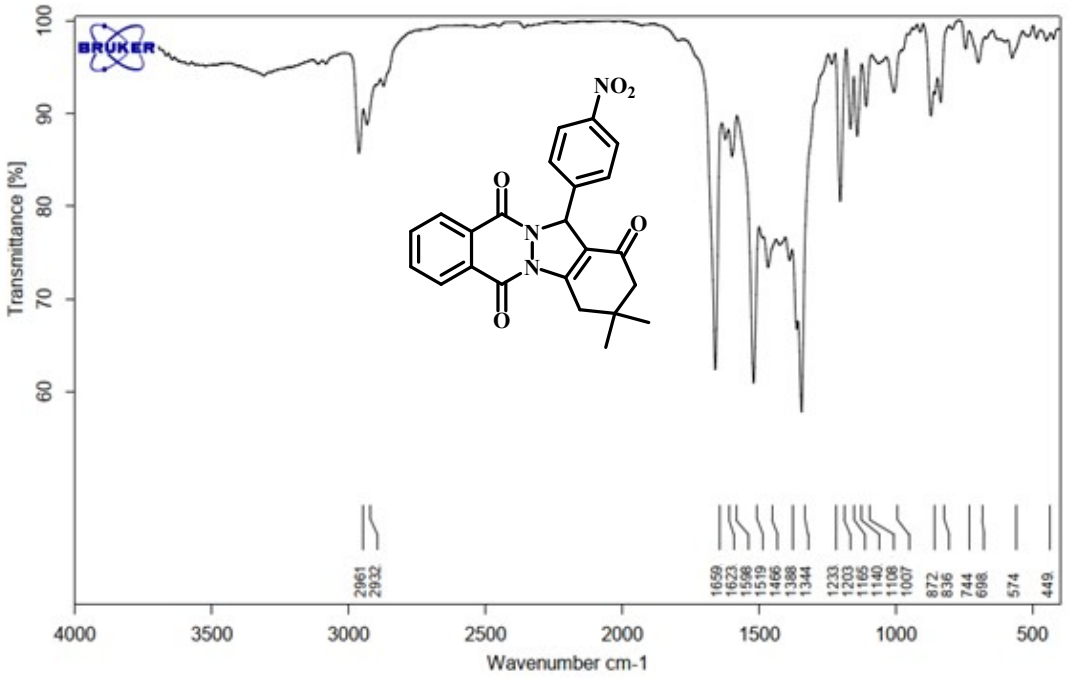

Figure S17: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-nitrophenyl)-2*H*-indazolo[2,1-*b*]phthalazine-1,6,11(13*H*)-trione

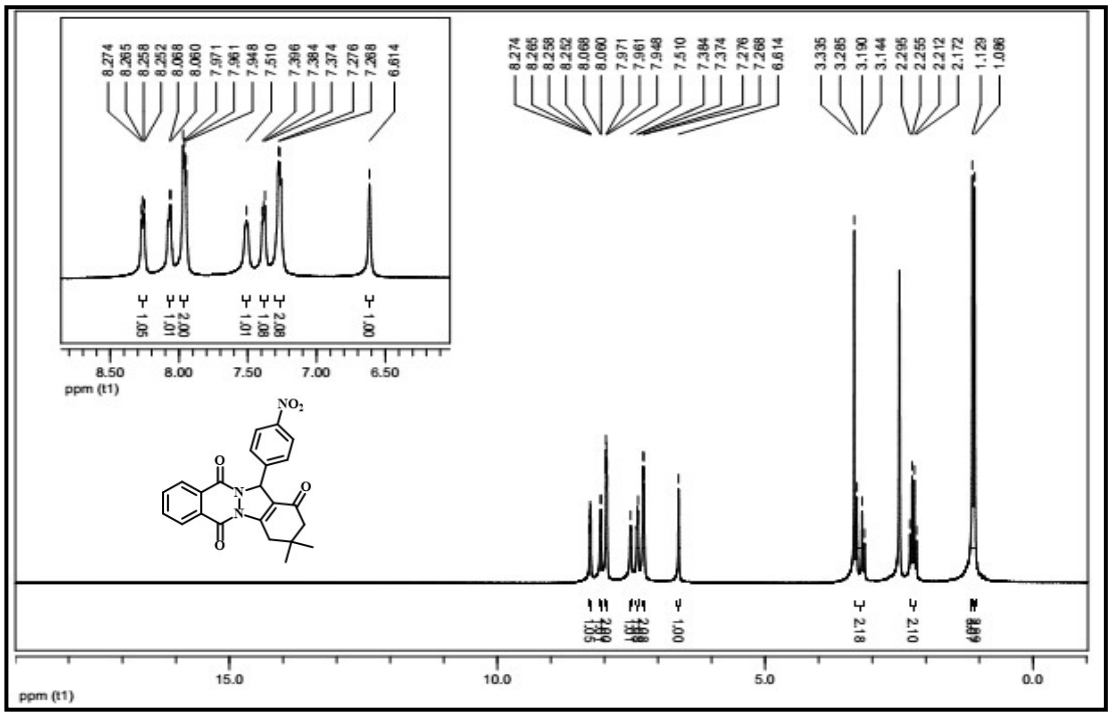

Figure S18: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-nitrophenyl)-2*H*-indazolo[2,1-*b*]phthalazine-1,6,11(13*H*)-trione

3,4-Dihydro-3,3-dimethyl-13-(4-isopropylphenyl)-2*H*-indazolo[2,1-*b*]phthalazine-1,6,11(13*H*)-trione

Yellow solid, FT-IR(KBr) $\bar{\upsilon}$ (cm^{-1}): 2960, 1662, 1595, 1493, 1374, 1328, 1259, 1078, 826, 788. ^{1}H NMR (DMSO-d_6, 400MHz /δ ppm): 1.03 (s, CH_3), 1.14 (s, CH_3), 1.22 (m, 12H), 2.23 (s, CH_2), 2.9 (m, CH), 3.26-3.38 (m, CH_2), 5.95 (s, CH), 6.91-8.08 (m, 8H).

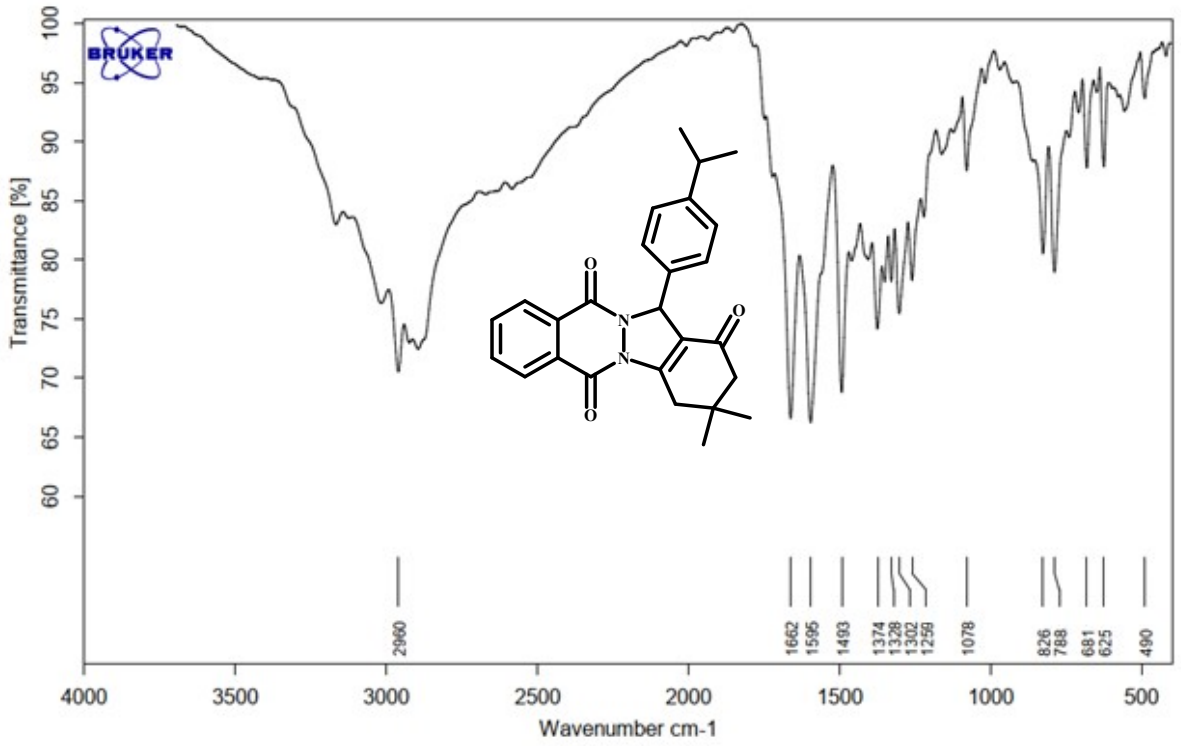

Figure S19: IR (KBr) spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-isopropylphenyl)-2*H*-indazolo[2,1-*b*]phthalazine-1,6,11(13*H*)-trione

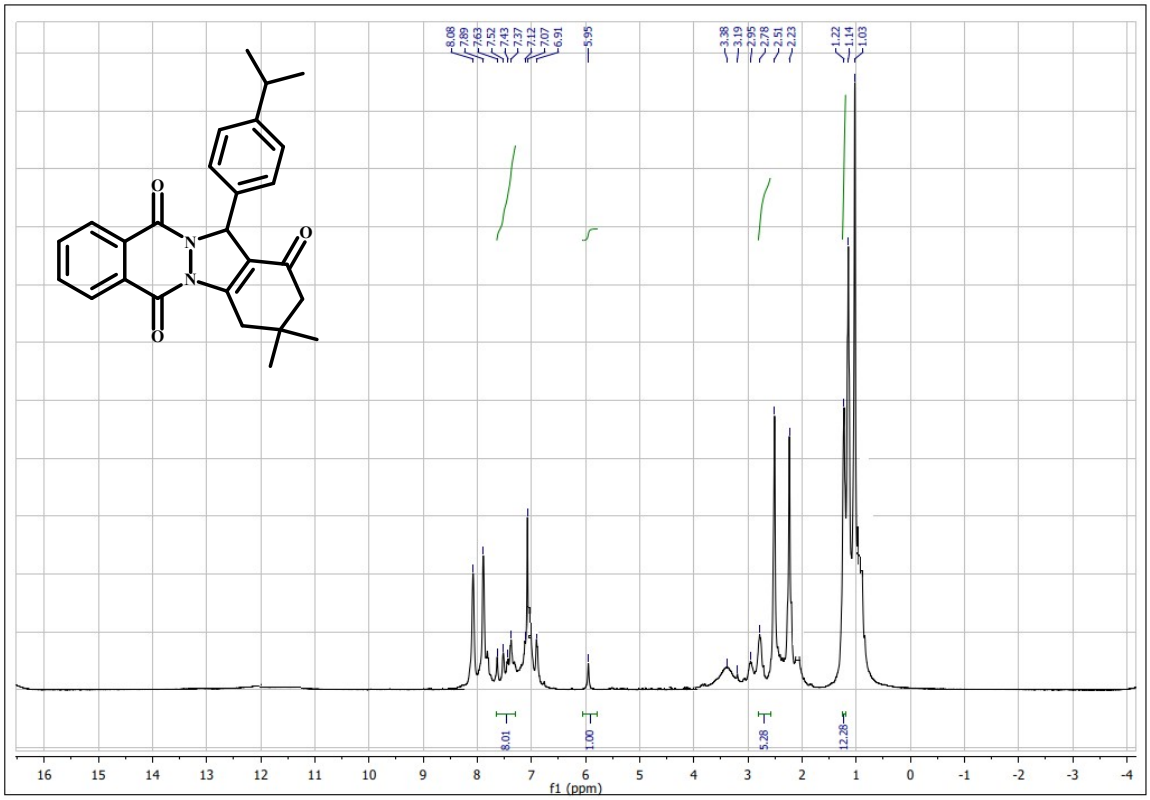

Figure S20: ^{1}H NMR spectrum of 3,4-Dihydro-3,3-dimethyl-13-(4-isopropylphenyl)-2*H*-indazolo[2,1-*b*]phthalazine-1,6,11(13*H*)-trione

Section S2. Characterization of Sb(III)/Gum Arabic composite

Code	Unit	Gum Arabic-Sb
Sb	ppm	431186.55
Sb	%	43.12

Figure S21: inductively coupled plasma (ICP).

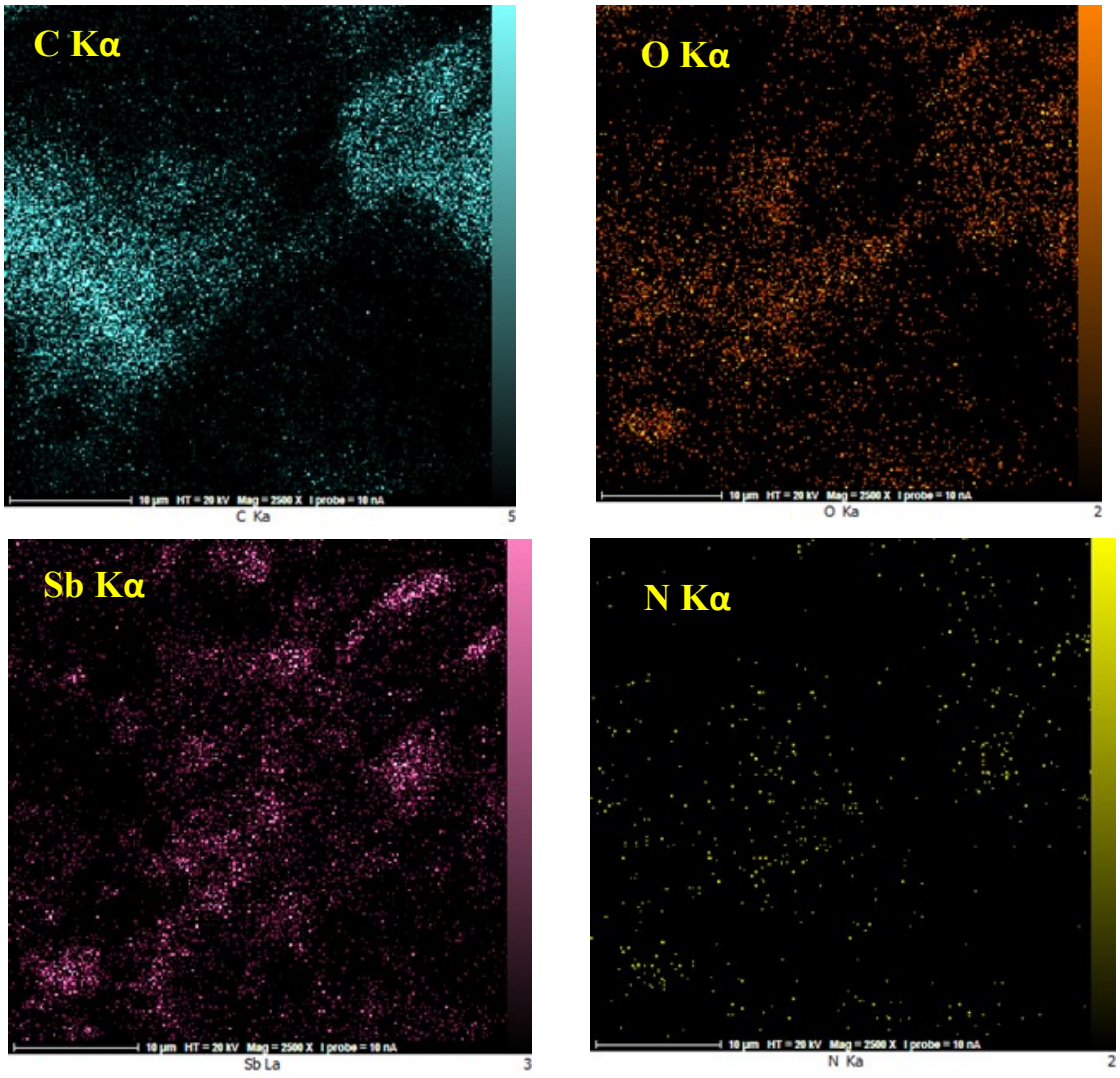

Figure S22: Elemental mapping images of Sb(III)/Gum Arabic composite

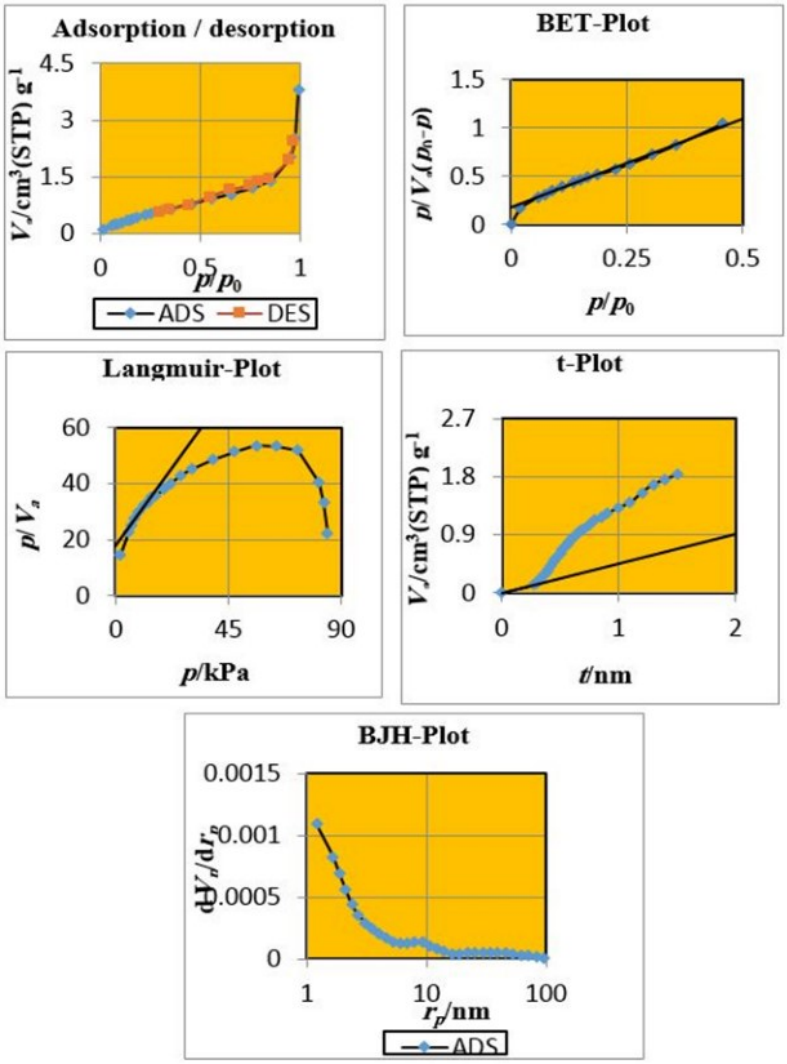

Figure S23: Diagrams calculated from the porosity measuring device