

Morphology controlled phosphate grafted SnO₂-ZrO₂ nanocomposite oxides prepared by urea hydrolysis method as efficient heterogeneous catalyst towards synthesis of 3-substituted indoles

Sagnika Pradhan, Jagannath Saha, B.G. Mishra*

Department of chemistry, National Institute of Technology, Rourkela, Odisha-769008, India

Supplementary information

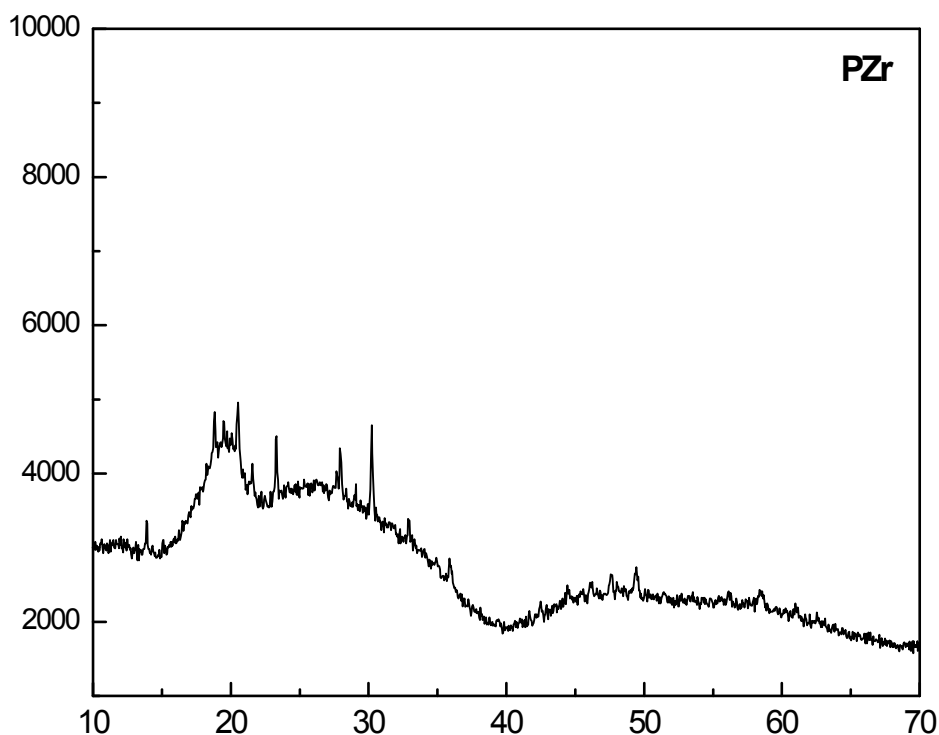


Fig. S1. XRD pattern of PZr material.

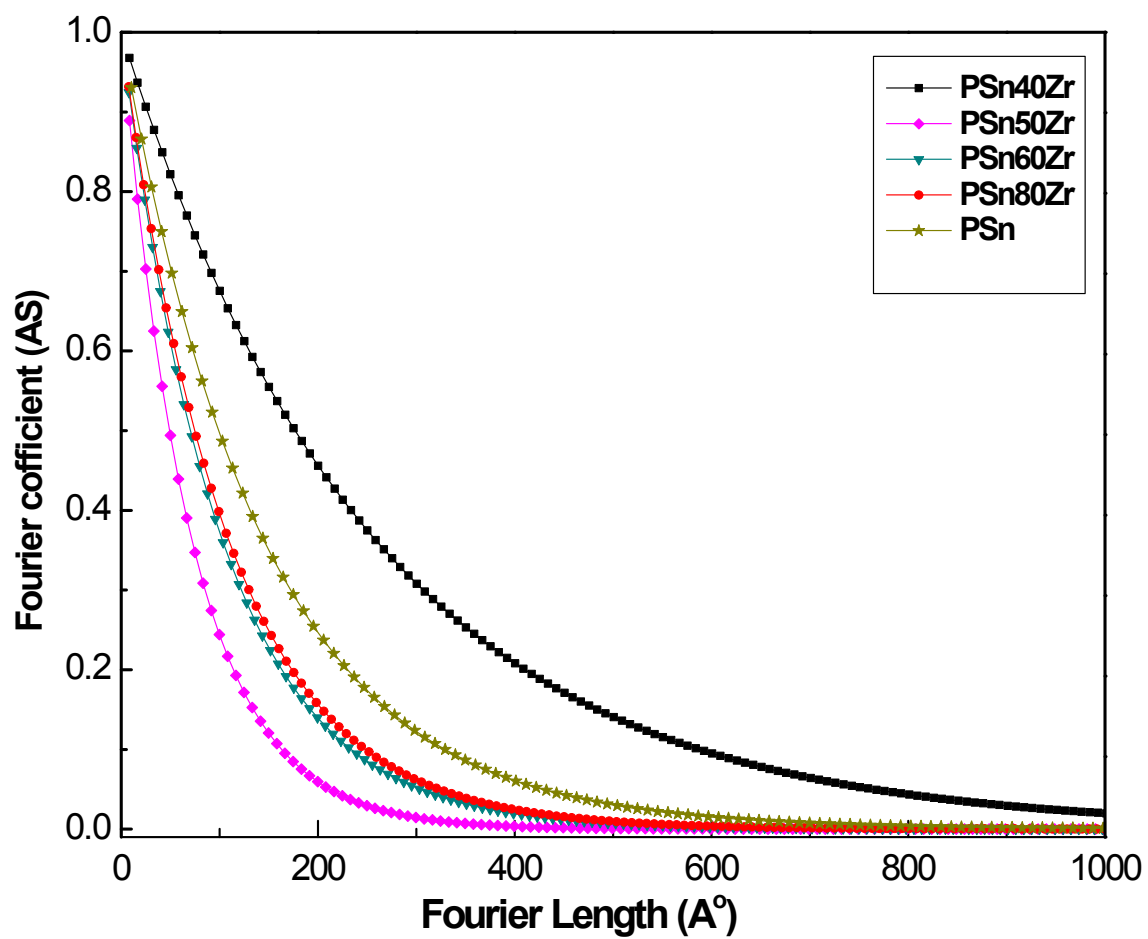


Fig. S2. Fourier size coefficient (As) \sim L plots for the SnO₂ component in the PSn_xZr composite materials.

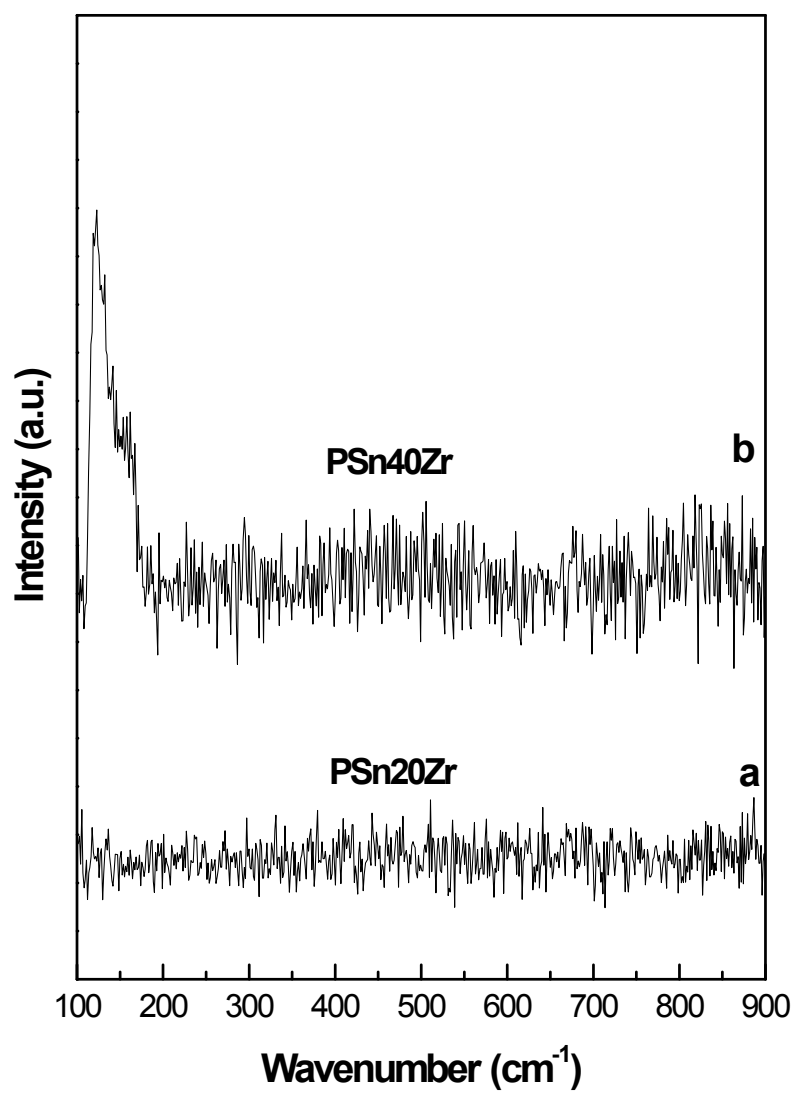
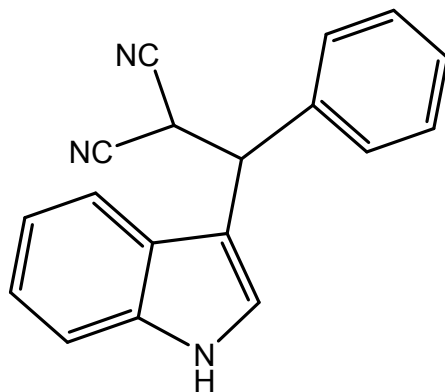


Fig. S3. Raman spectra of (a) PSn20Zr and (b) PSn40Zr.

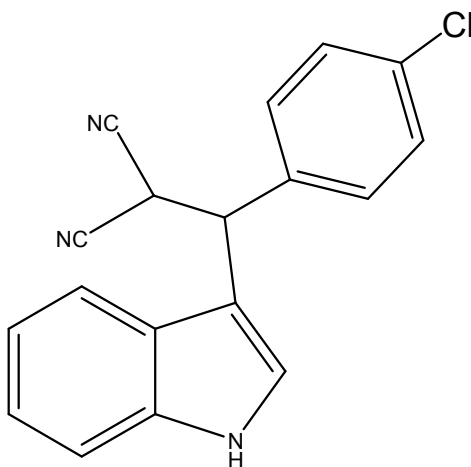
Physical and spectral datas of some 3-Substituted Indoles

2-((1H-indol-3-yl) (phenyl) methyl) malononitrile (Table 2, entry 1)



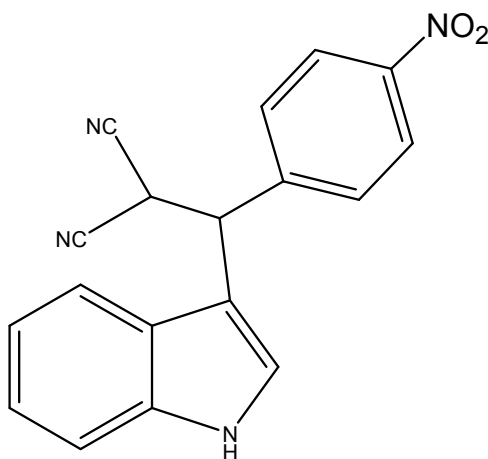
M.P. 83–85 °C. IR (KBr) 3344, 3033, 2884, 2255, 1622, 1458, 746 cm^{-1} . ^1H NMR (400 MHz, CDCl_3) δ 7.86 (s, 1H), 7.48-7.43 (m, 2H), 7.43-7.40 (m, 5H), 6.61 (d, 1H), 7.08 (t, 1H), 7.20 (t, 1H), 4.89 (d, 1H), 4.33 (d, 1H)

2-((1H-indol-3-yl) (4-chlorophenyl)methyl) malononitrile (Table 2, entry 2)



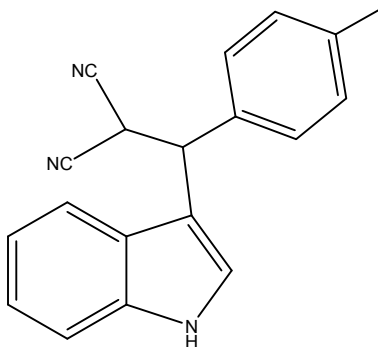
M.P. 168–170 °C, IR (KBr) 3397, 2855, 2942, 1584, 1456, 1363, 1300, 1275, 1222, 1110, 1020, 827, 664, 617 cm^{-1} . ^1H NMR (400 MHz, CDCl_3) δ 8.07 (s, 1H), 7.35-7.32 (m, 4H), 7.28 (d, 2H), 7.14 (t, 1H), 7.04 (t, 1H), 4.90 (d, 1H), 4.62 (d, 1H)

2-((1H-indol-3-yl)(4-nitrophenyl)methyl)malononitrile (Table 2, entry 3)



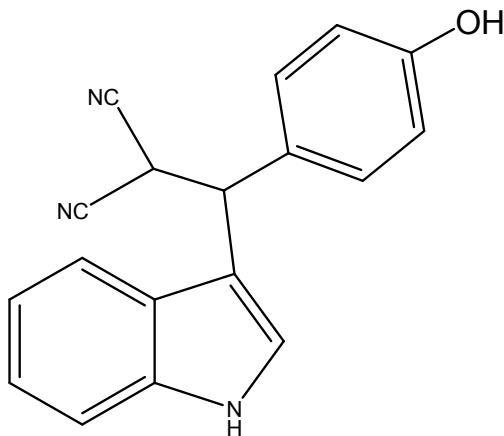
M.P. 190–192 °C, IR (KBr) 3377, 3053, 2891, 2256, 1605, 1527, 1420, 1350, 743 cm^{-1} . ^1H NMR (400 MHz, CDCl_3) δ 10.33 (s, 1H), 8.24 (d, 2H), 7.81 (d, 2H), 7.60 (s, 1H), 7.47 (d, 1H), 7.41 (d, 1H), 7.10 (t, 1H), 6.96 (t, 1H), 5.98 (d, 1H), 5.52 (d, 1H)

2-((1H-indol-3-yl)(p-tolyl)methyl)malononitrile (Table 2, entry 8)



M.P. 120-122°C. IR (KBr) 3351, 3034, 2882, 2224, 1587, 1458, 744 cm^{-1} . ^1H NMR (400 MHz, CDCl_3) δ 10.22 (s, 1H), 7.88 (d, 1H), 7.46 (d, 1H), 7.45 (s, 1H), 7.40 (d, 2H), 7.16 (d, 2H), 7.11-6.97 (m, 2H), 5.81 (d, 1H), 5.16 (d, 1H), 2.26 (s, 3H)

2-((1H-indol-3-yl)(4-hydroxyphenyl)methyl)malononitrile (Table 2, entry 10)



M.P. 179-181° C. IR (KBr) 3353, 2899, 2226, 1566, 1445, 744 cm^{-1} . ^1H NMR (400 MHz, CDCl_3) δ 10.17 (s, 1H), 7.88 (d, 1H), 7.41 (d, 1H), 7.27 (d, 2H), 7.18 (s, 1H), 7.08 (t, 1H), 6.70 (t, 1H), 6.67 (d, 2H), 5.71 (d, 1H), 5.11 (d, 1H), 3.41 (broad, 1H)