# Scalable Phase-Rich Mixed Oxide/ Perovskites: Hetero-Interfacial Tuning Catalysed Photocatalysis Via pH/Temperature Regulations

Dharanya. C [1], Gnanaprakash Dharmalingam[*,1]

[*1] Plasmonic nanomaterials laboratory, PSG Institute of Advanced Studies, Coimbatore-641004, Tamilnadu, India.[*] dgp@psgias.ac.in

## SUPPORTING INFORMATION

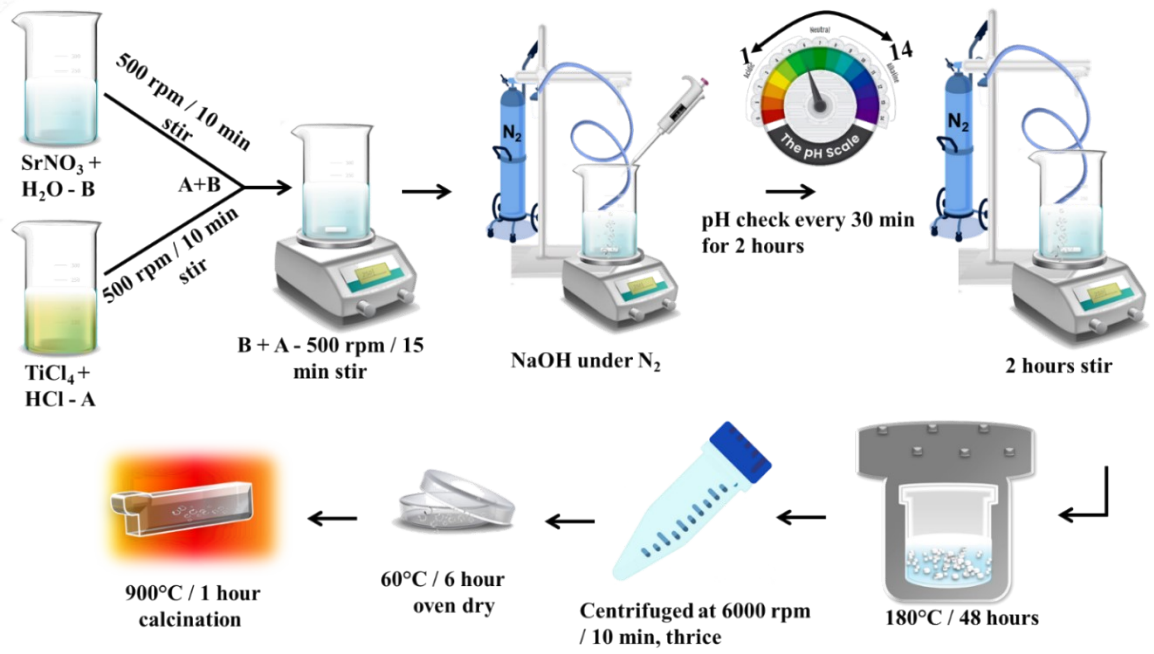


Fig S1: Synthesis protocol for development of homo/hetero interfacial mixed oxide composites

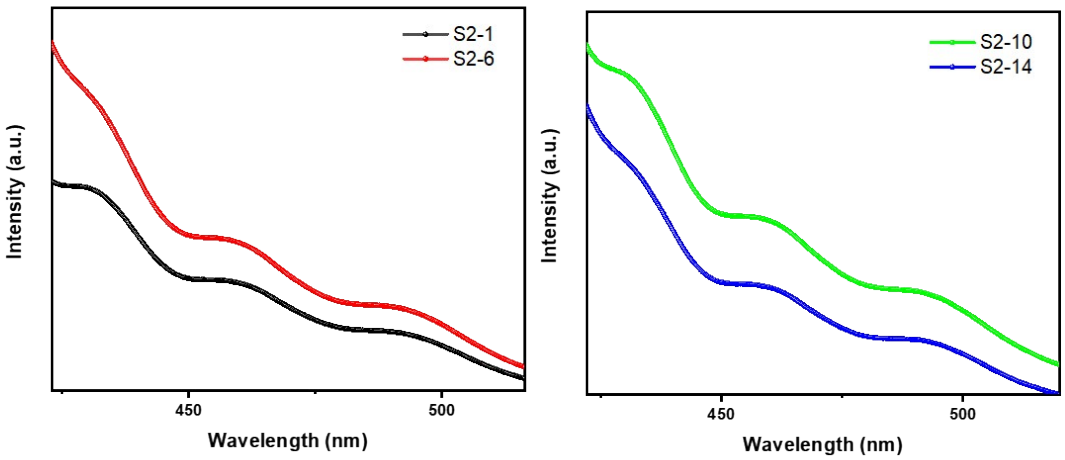


Fig. S2: Magnified graphs of defect level emissions from all samples in trial 2.

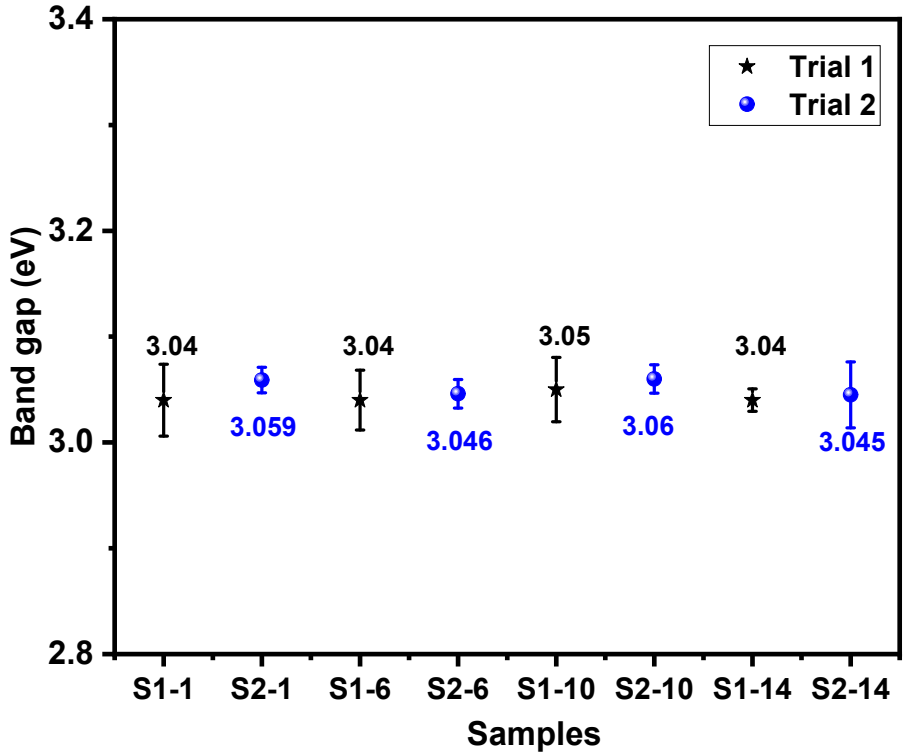


Fig S2: Band gaps of trial 2 and trial 1 samples.

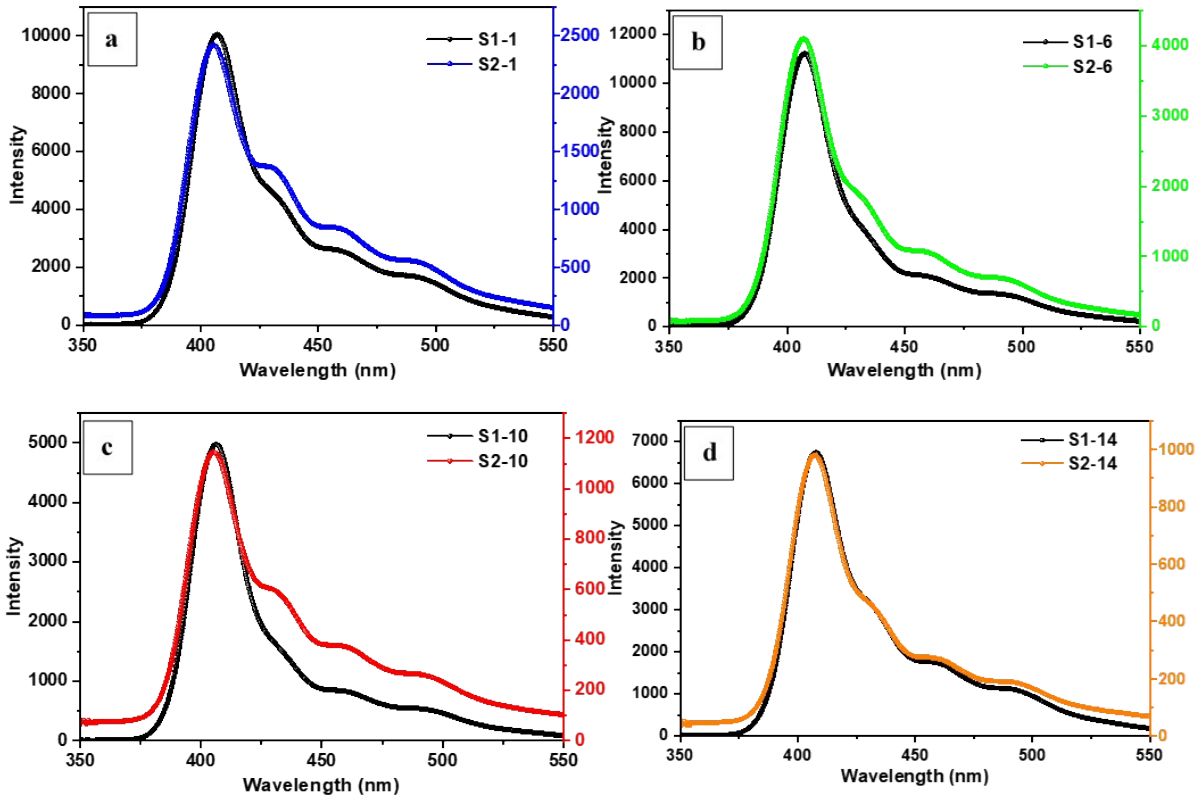


Fig. S4: PL spectra of STO at different pH for both trial 1 and trial 2

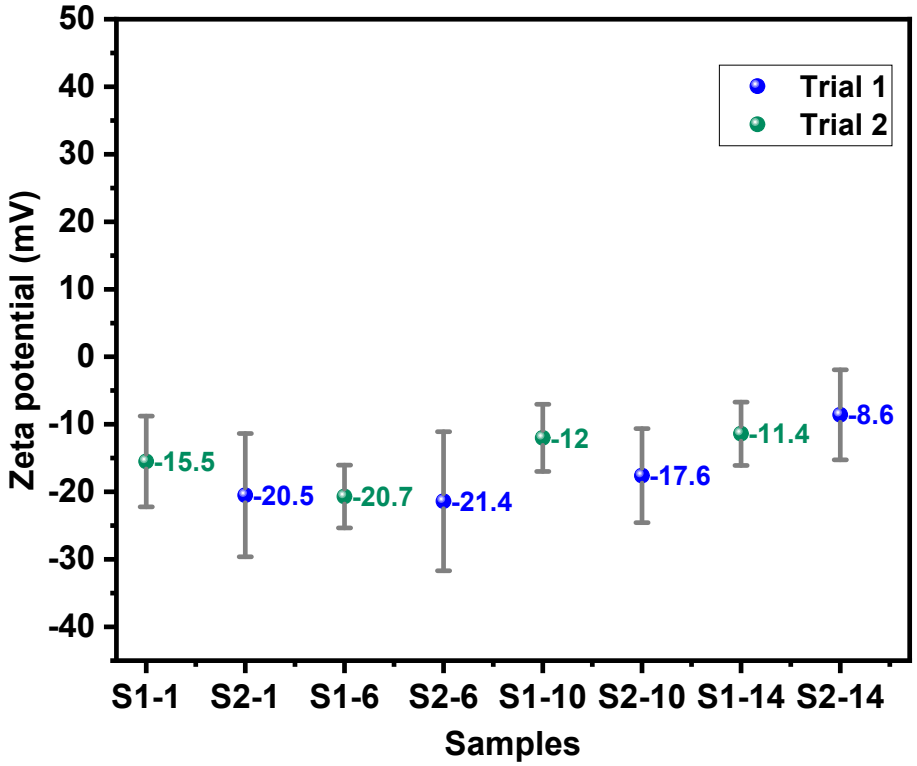


Fig. S5: Repeatability validations on Zeta potential measurements for trial 1 and trial 2 samples with standard deviations.

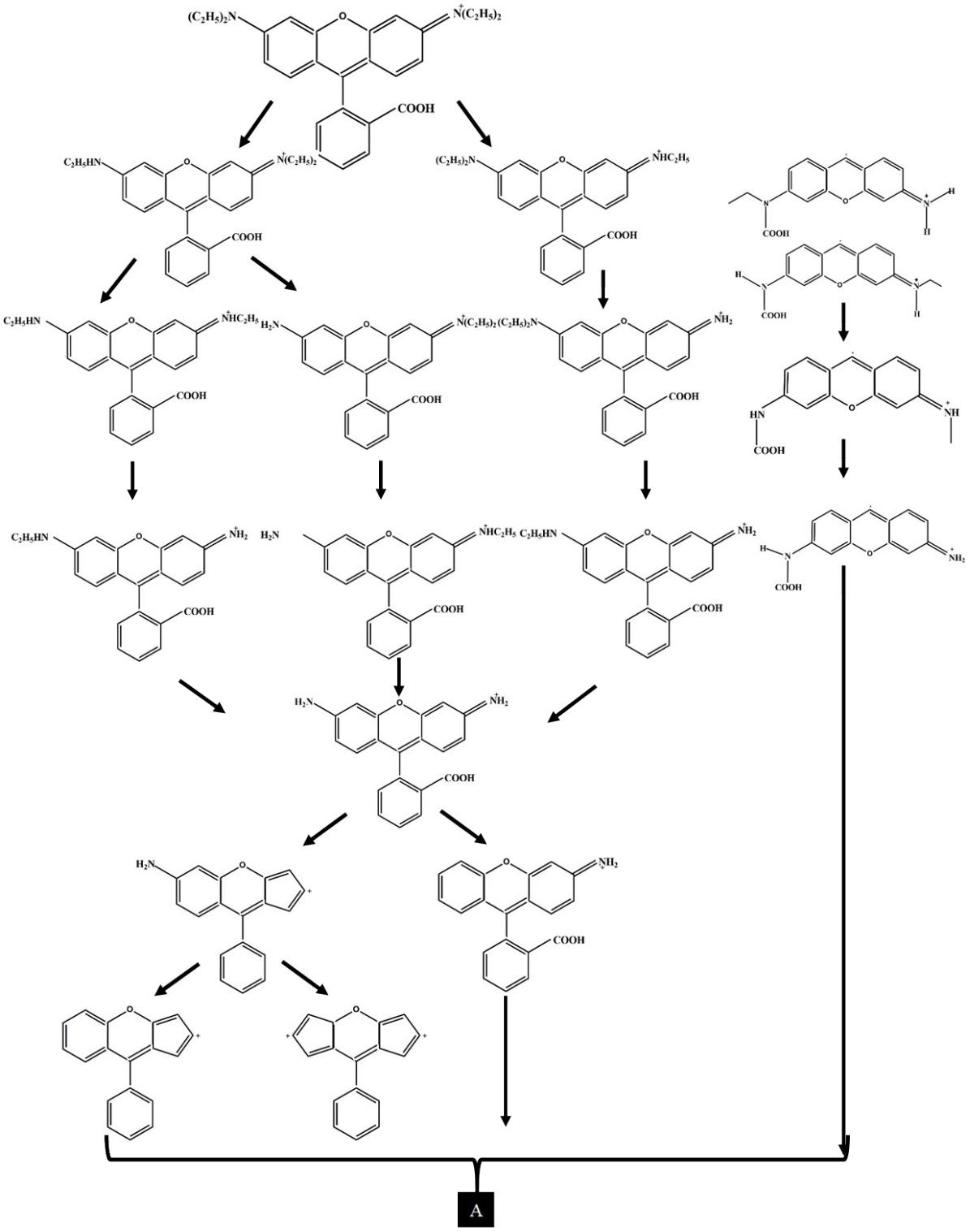


FIGURE S6: Degradation pathways of RhB

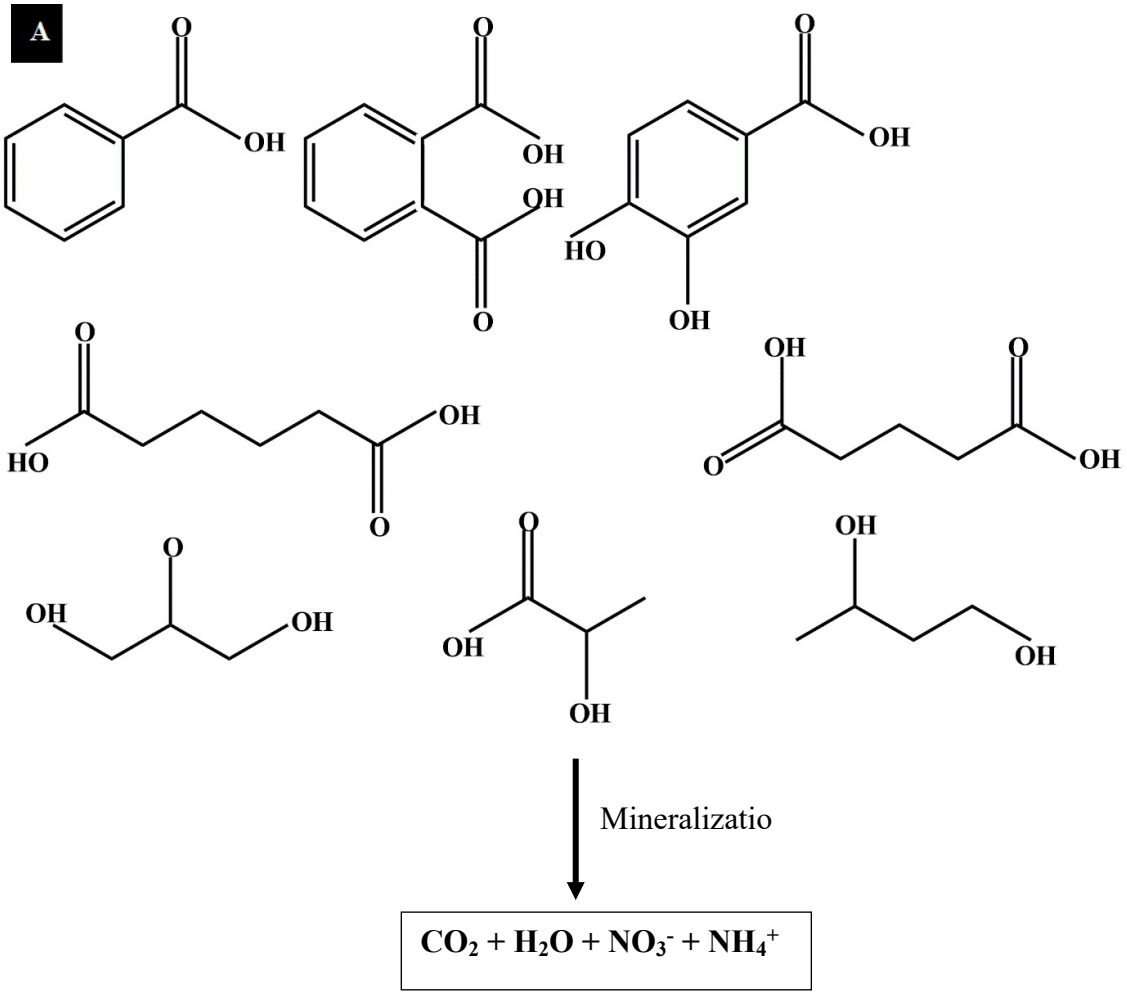


FIGURE S7: Cleavage of chromophore and mineralization

Table S1: Crystallographic parameters from repeatability investigations

| Sample | Phases | Reference parameters | Parameters from manual calculation (Å) | Parameters from Rietveld Refinement (Å) | Distortion from manual calculation (%) | Distortion from Rietveld Refinement (%) | Grain Size (nm) |
|---|---|---|---|---|---|---|---|
| S1-14 | STO | a= 3.9049 | a= 3.916 | a = 3.90579 | a= -0.28 | a= -0.15873 | 6.79 |
| S2-14 | STO | a= 3.9049 | a= 3.909 | a= 3.9090 | a= -0.1049 | a= -0.1049 | 5.71 |
| S1-10 | Anatase | a= 3.7845 c= 9.5143 | a= 3.7796 c= 9.5030 | a = 3.73599 c = 12.0593 | a= 0.129 c= 0.118 | a= 1.28181 c= -26.7489 | 10.04 |
| | Rutile | a= 4.5929 c= 2.9591 | a= 4.5866 c= 2.9576 | a = 4.57475 c = 2.97792 | a= 0.137 c= 0.051 | a= 0.39734 c= -0.63940 | 7.16 |
| | STO Cubic | a= 3.9049 | a= 3.9029 | a = 3.90505 | a= 0.051 | a= -0.13975 | 7.13 |
| S2-10 | Anatase | a= 3.7845 c= 9.5143 | a= 3.7862 c= 9.5129 | a= 3.73 c= 9.37 | a= -0.045 c= 0.015 | a= 1.44 c= 1.5166 | 11.46 |
| | Rutile | a= 4.5929 c= 2.9591 | a= 4.601 c= 2.960 | a= 4.623 c= 2.986 | a= -0.176 c= -0.030 | a= -0.655 c= -0.9090 | 7.39 |
| | STO cubic | a= 3.9049 | a= 3.9113 | a= 3.9075 | a= -0.164 | a= -0.066 | 6.28 |
| S1-6 | Rutile | a= 4.5929 c= 2.9591 | a=4.5912 c=2.9581 | a = 4.59079 c = 2.95729 | a= 0.037 c=0.033 | a=0.04812 c=0.05779 | 8.82 |
| | STO | a= 3.9049 | a=3.9063 | a = 3.8816 | a= -0.035 | a= 0.46158 | 5.94 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| S2-6 | Rutile | a= 4.5929<br>c= 2.9591 | a=4.5909<br>c=2.9588 | a= 4.5917<br>c= 2.9583 | a=0.044<br>c=0.01 | a= 0.02<br>c= 0.027 | 7.43 |
| | STO | a= 3.9049 | a=3.9099 | a= 3.9106 | a= -0.128 | a= -0.14 | 4.96 |
| S1-1 | Rutile | a= 4.5929<br>c= 2.9591 | a=4.5853<br>c=2.9549 | a = 4.58977<br>c = 2.95617 | a=0.1654<br>c=0.142 | a=0.07032<br>c= 0.09564 | 7.58 |
| S2-1 | Rutile | a= 4.5929<br>c= 2.9591 | a=4.5914<br>c=2.9581 | a= 4.5917<br>c= 2.9584 | a=0.033<br>c=0.034 | a= 0.026<br>c= 0.023 | 8.6 |

Table S2: comprehensive list of reaction intermediates in RhB dye degradation

| Sl No. | Material | Source wavelength | Parameters optimized | Degradation Products | Degradation % in 60 mins | Reference |
|---|---|---|---|---|---|---|
| 1 | P-25 $TiO_2$ | UV-LED (390-410 nm) | Catalyst loading, Initial dye concentration, pH and addition of $H_2O_2$ | • N-de-ethylated intermediate<br>• benzoic acid, phthalic acid, 3,4-dihydroxybenzoic acid, adipic acid, glutaric acid, 2-hydroxypropanoic acid, propane-1,2,3- triol, and butane-1,3-diol<br>• $CO_2$, $H_2O$, $NO^{3-}$ and $NH^{4+}$. | 75% | [1] |
| 2 | $Fe_2O_3$/ ZnO | Hg lamp (365 nm) | Catalyst loading | • $CO_2$ and $H_2O$ | 60% | [2] |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | $Fe_3O_4$/ZnO/g-$C_3N_4$ | 250-W Xe lamp<br>250-W Hg lamp | Catalyst loading | • small molecules and $CO_2$ | 60% | [3] |
| 4 | $TiO_2/SiO_2$ | Mercury lamp<br>Xenon lamp | UV and visible light sources | • de-ethylation products | 86% | [4] |
| 5 | $Bi_2WO_6$ | MW-assisted electrodeless discharge lamp (EDML) (190-330nm) | pH, electron accepting agent, ex: air and $H_2O_2$ | • N-De-ethylation products<br>• chromophore cleavage<br>• succinic acid, benzoic acid, adipic acid, 3-hydroxybenzoic acid, phthalic acid, etc | 90% | [5] |
| 6 | $NaBiO_3$ | 750-W xenon lamp (400 nm) | Catalyst heating temperature | • N-de-ethylation intermediates<br>• Small molecular intermediates | 100% | [6] |
| 7 | SrTiO3/TiO2 heterostructure nanosheets | 300W Xe arc lamp | Catalyst preparation, catalyst loading | Not studied | ~90% | [7] |
| 8 | SrTiO3/TiO2 | 300 W Xe lamp | Ratio of STO to TiO2 | Not studied | ~70% | [8] |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | TiO2-SrTiO3 | 400 W halogen light | Reaction time of catalyst synthesis | Not studied | ~60% | [9] |
| 10 | $TiO_2$-mixed phases/$SrTiO_3$ | 400-L-HP LED light source | pH, reaction time and temperature of catalyst in synthesis conditions | Not studied | 60% | This work |

## References:


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