Supplementary Information

A novel three-dimensional spherical $CuBi_2O_4$ nanocolumn arrays with high performance persulfate and peroxymonosulfate activation functionalities for 1H-benzotriazole removal

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Fig. S1 shows the morphology of the $CuBi_2O_4$ prepared with different hydrothermal conditions. From (a), temperature control resulted in a 3-D spherical nanocolumns arrays morphology with hollow core structure (b). Increasing the Cu to Bi concentration above the optimum condition resulted in the destruction of the CuB-H morphology (c). Decreasing the initial precursor concentration resulted in the decrease of microsphere size (d). The microsphere size can also be controlled by increasing the Cu to Bi ratio but resulted in CuO impurity.

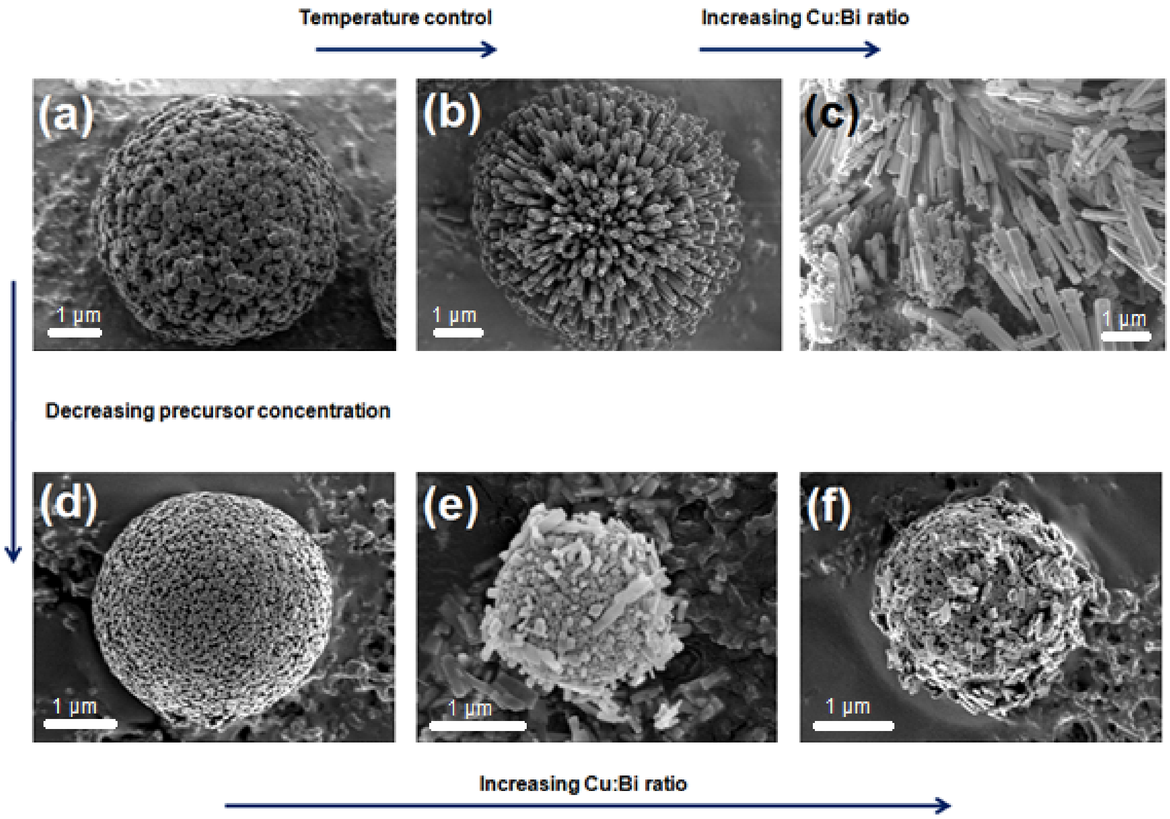

Figure S1: The FESEM images of $CuBi_2O_4$ prepared with different conditions.

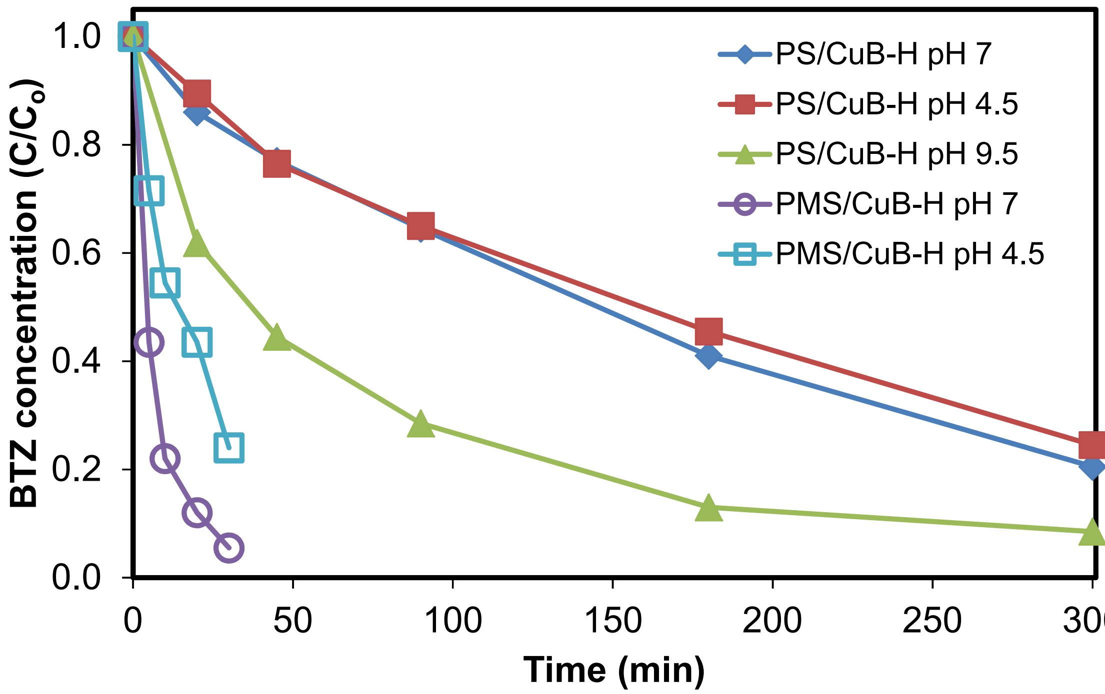

Fig. S2: Effects of pH of the degradation of BTZ. Conditions: [CuB-H] = 0.5 g L^{-1}, $[PS]_o$ = 0.1 g L^{-1}, $[PMS]_o$ = 0.05g L^{-1} and $[BTZ]_o$ = 2.5 mg L^{-1}. At pH 9.5 for the PMS/CuB-H system, BTZ was completely removed in less than 5 min.

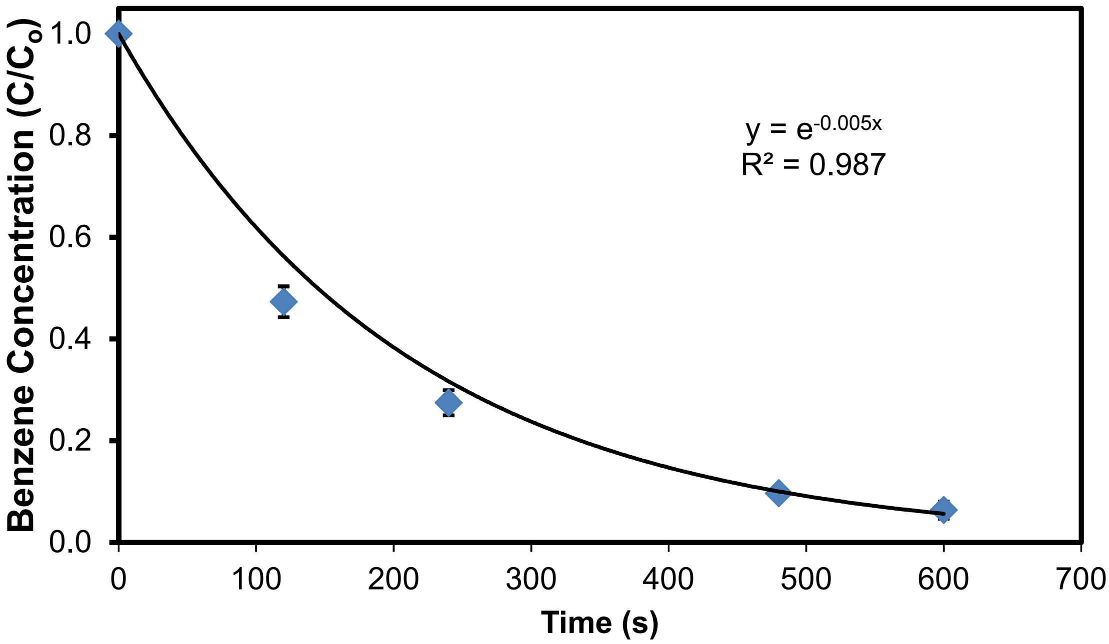

Fig. S3: Benzene oxidation by $SO_4^{\bullet -}$. Without catalyst, the benzene removal was < 5%. Conditions: $[Benzene]_o$ = 2.5 mg L^{-1}, [CuB-2.5] = 0.5 g L^{-1}, $[PMS]_o$ = 0.2 g L^{-1}, $[pH]_o$ = 7.

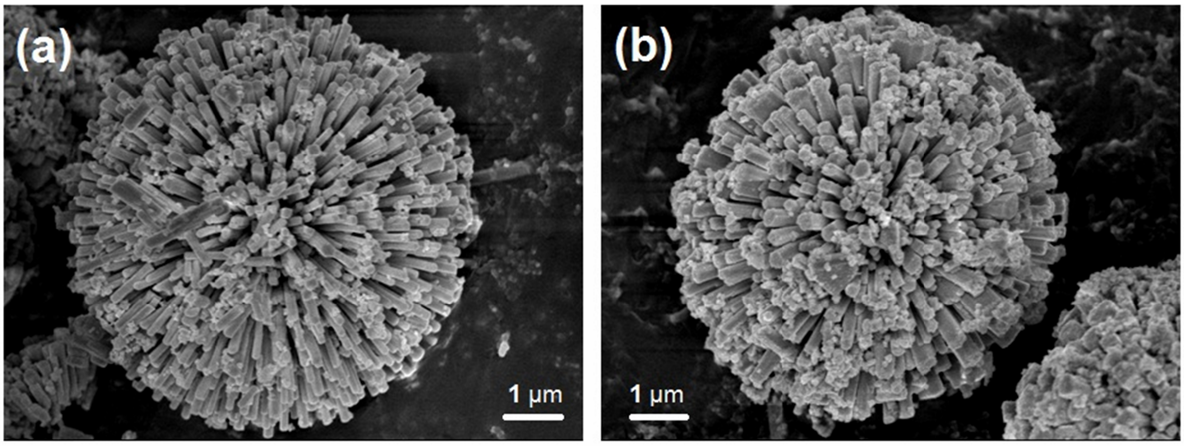

Figure S4: The FESEM images of $CuBi_2O_4$ after catalytic reaction with (a) PS and (b) PMS. Reaction conditions: $[BTZ]_o$ = 2.5 mg L^{-1}, $[PS]_o$ = 0.8 g L^{-1}, $[oxone]_o$ = 0.6 g L^{-1}, t_{PS} = 90 min and t_{PMS} = 10 min.

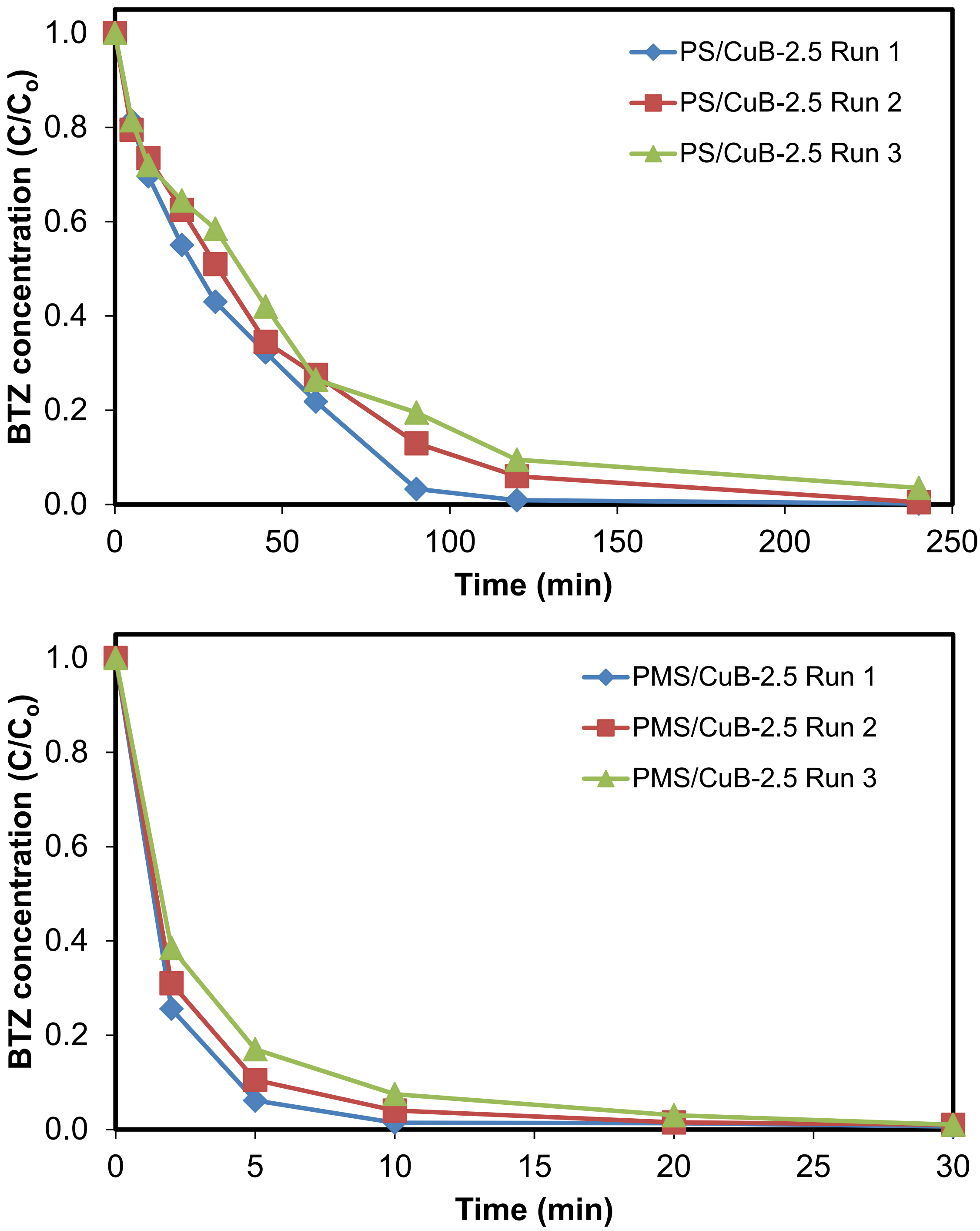

Fig. S5: The reusability of CuB-2.5 catalyst for 3 cycles for (a) PS/CuB-2.5 and (b) PMS/CuB-2.5 systems. Conditions: [CuB-2.5] = 0.5 g L^{-1}, $[BTZ]_o$ = 2.5 mg L^{-1}, $[PS]_o$ = 0.8 g L^{-1}, $[PMS]_o$ = 0.2 g L^{-1}.

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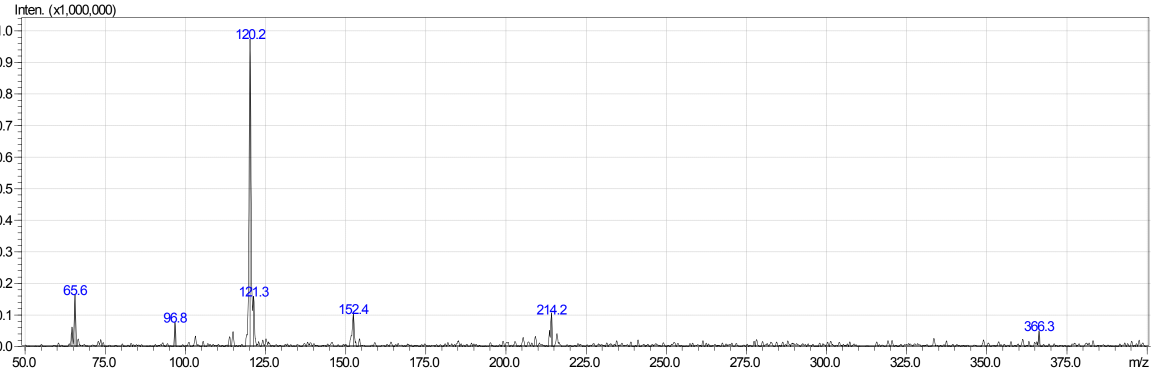
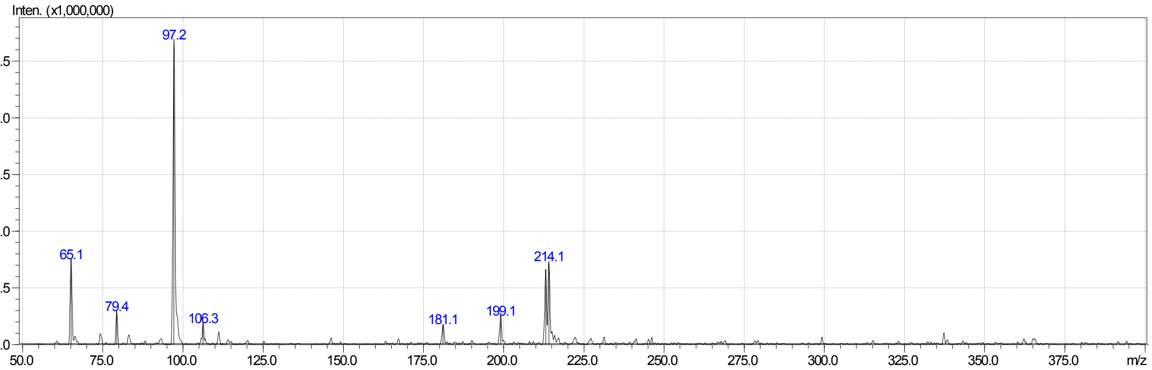
(a) Initial BTZ solution



(b) After PS oxidation



(c) After PMS oxidation

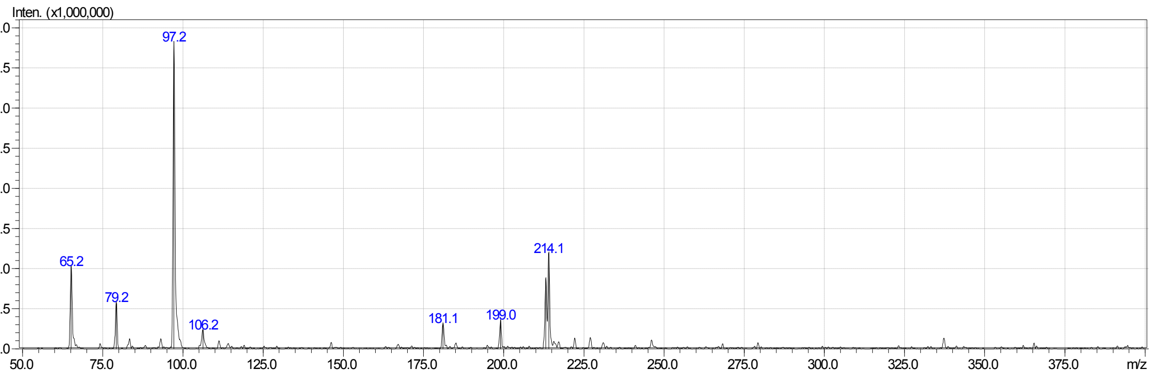


Fig. S4: Mass spectrum of initial BTZ solution and BTZ solution after treatment with (b) PS and (c) oxone. Reaction conditions: $[BTZ]_o = 2.5$ mg L^{-1}, $[CuB\text{-}2.5]_{PS} = 2.0$ g L^{-1}, $[CuB\text{-}2.5]_{PMS} = 0.5$ g L^{-1}, $[PS]_o = 0.8$ g L^{-1}, $[PMS]_o = 0.2$ g L^{-1}, $t_{PS} = 90$ min and $t_{PMS} = 10$ min.