

Electronic Supplementary Information

Co-digestive ripening assisted phase-controlled synthesis of Ag-Sn intermetallic nanoparticles and its dye degradation activity

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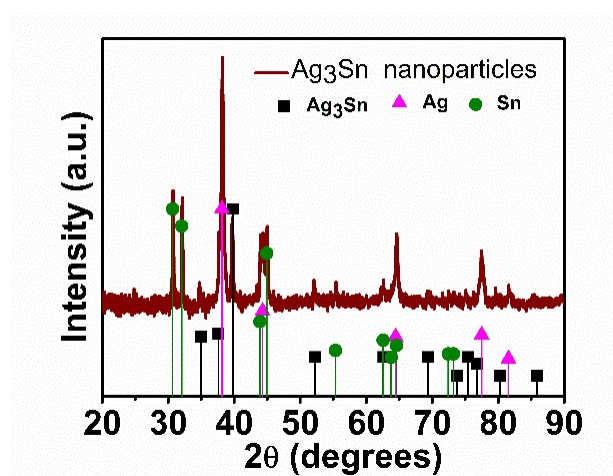


Fig. S1 Powder -X ray diffraction pattern of Ag-Sn intermetallic nanoparticles using mesitylene as solvent (165 °C bp) ; ratio of Ag and Sn was 2:1, TOP:TOPO as capping agents (Metal:TOP:TOP 1:10:10).

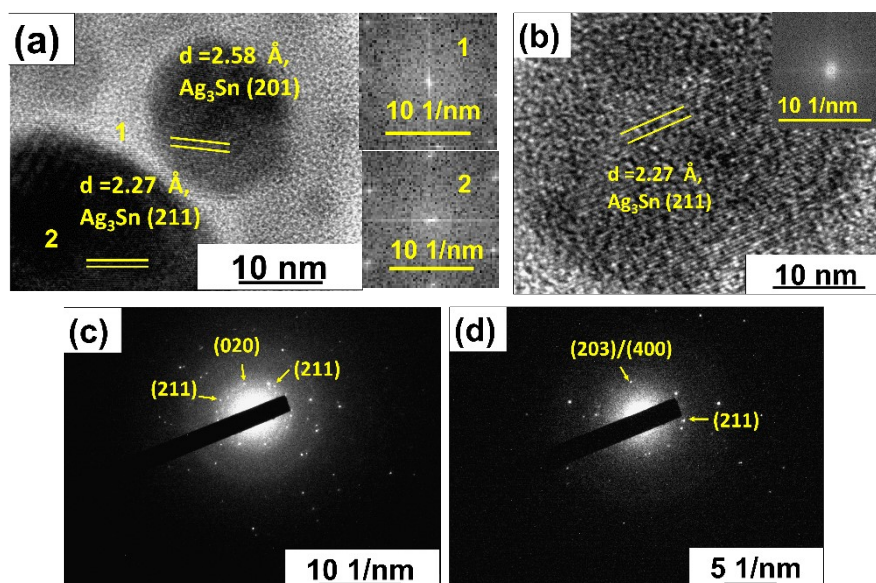
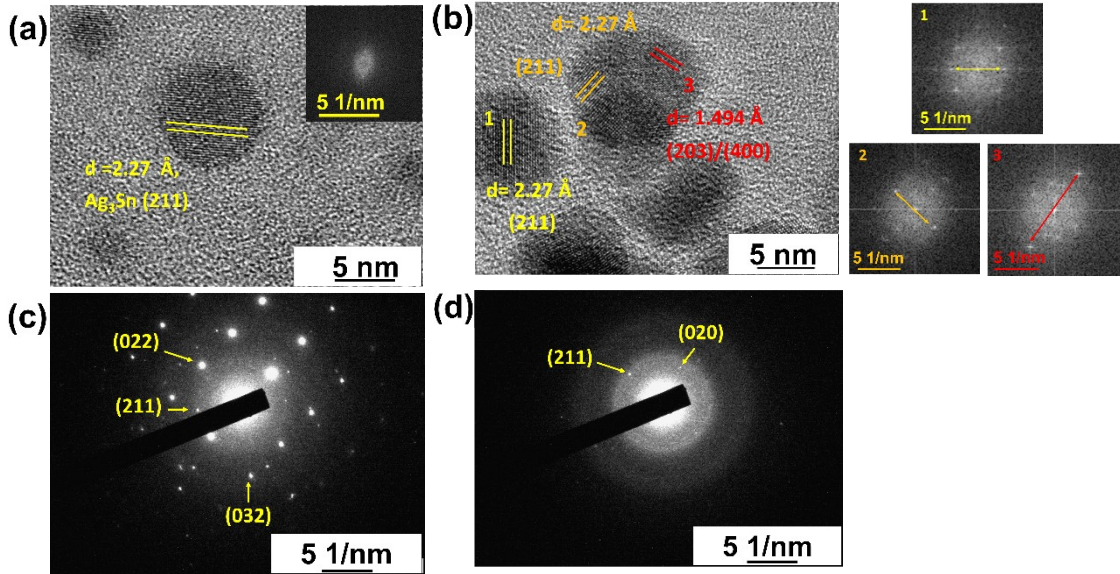


Fig. S2
Ag₃Sn



intermetallic nanoparticles (Metal:TOP:TOPO = 1:10:10): (a, b) HRTEM image: Insets: corresponding FFT patterns respectively; (c and d) SAED patterns after 6 h and 12 h of reflux, respectively.

Fig. S3 Ag₃Sn intermetallic nanoparticles (M:TOP:TOPO = 1:30:30, M=Ag,Sn) : (a-b) HRTEM image and (1-3)corresponding FFT patterns ; (c-d) SAED patterns of nanoparticles after 6 h and 24 h reflux, respectively.

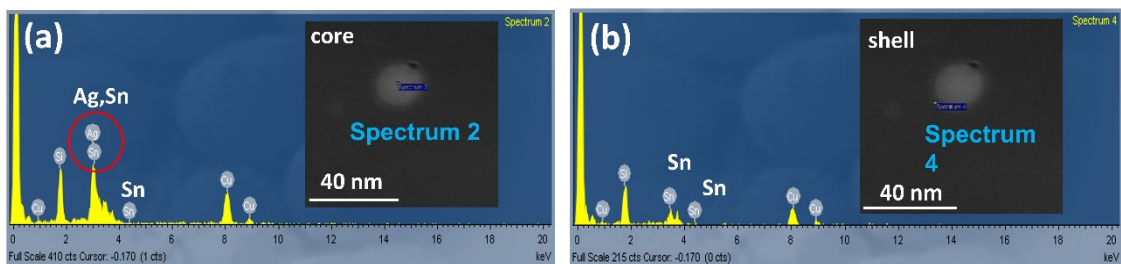


Fig. S4 Ag-Sn nanostructures (M:palmitic acid 1:.30, M=Ag,Sn) : point-EDS spectrum recorded by scanning single point on the particle (a) inside the core (b) on the shell.

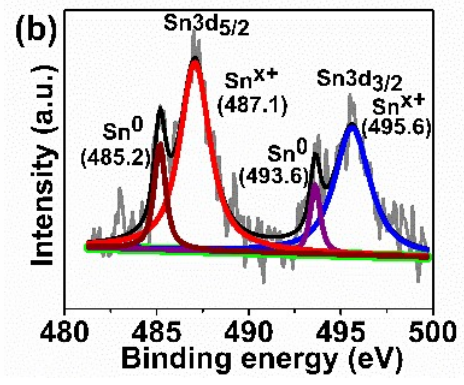
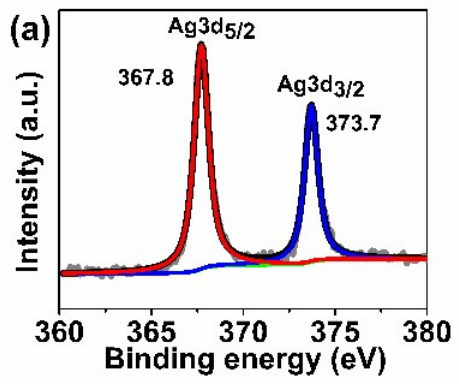


Fig. S5 XPS fittings corresponding to Ag₃Sn nanoparticles (M:TOP:TOPO = 1:30:30 ((M=Ag,Sn), 24 h, 205 °C : (a) Ag 3d (b) Sn 3d spectra.

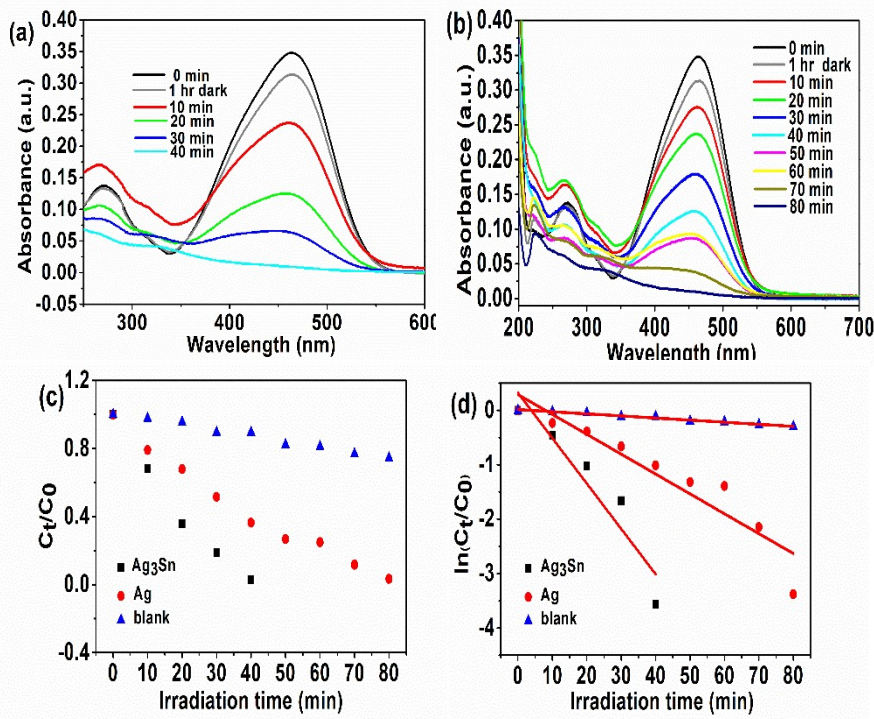
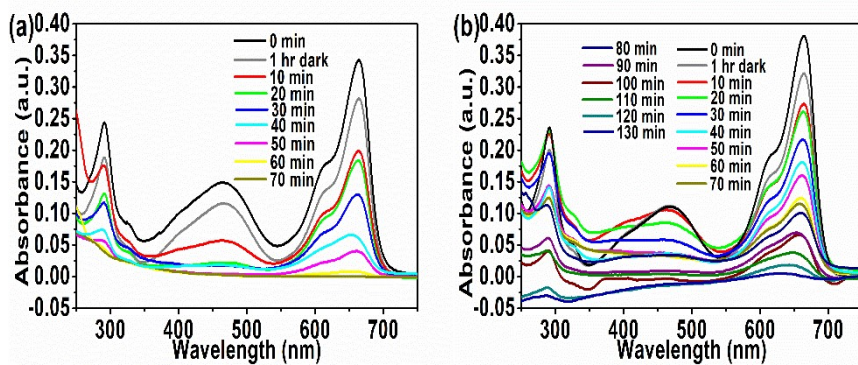


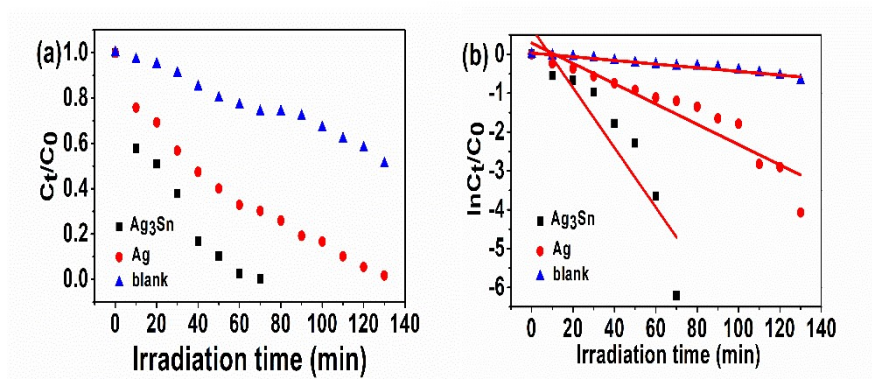
Fig. S6 UV-visible spectra of MO solutions at different irradiation times in presence of catalyst: (a) Ag₃Sn;



(b) Ag nanoparticles (c)) plot of C_t/C_0 versus irradiation time; (d) plot of $\ln(C_t/C_0)$ versus irradiation time.

Fig. S7 UV-visible spectra of MO+MB solutions at different irradiation times in presence of catalyst: (a) Ag_3Sn ; (b) Ag NPS.

Fig. S8 Photodegradation of MB in a mixture of MO+MB using Ag_3Sn and Ag catalysts : (a) plot of C_t/C_0 versus irradiation time; (b) plot of $\ln(C_t/C_0)$ versus irradiation time.



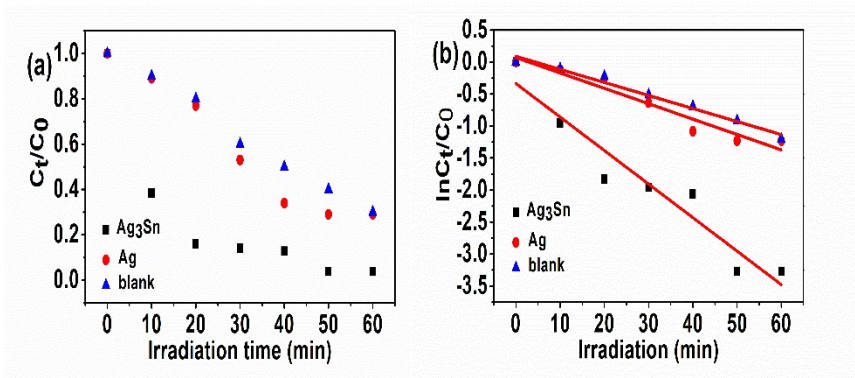
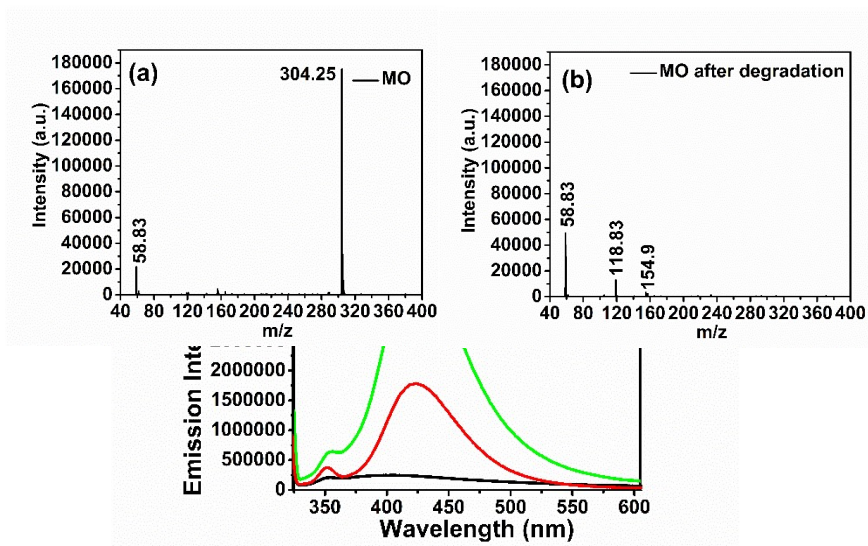


Fig. S9
of MO in a
MO+MB
Ag
of
irradiation
 $\ln(C_t/C_0)$
time.



Photodegradation
mixture of
using Ag₃Sn and
catalysts : (a) plot
 C_t/C_0 versus
time; (b) plot of
versus irradiation

Fig.S10 Photoluminescence spectra during UV light illumination of catalysts in terephthalic acid solution. (Excitation wavelength = 315 nm, black trace: blank solution; red trace: Ag ; green trace: Ag₃Sn).

We carried out LC-MS measurements of the dye degradation products.

Methyl orange: The full mass spectrograms before and after photocatalytic degradation of MO dye are shown in Fig. S11. A strong peak at m/z 304.25 in Fig. S1a corresponds to the parent molecule of MO. After complete degradation of MO i.e, for colorless solution (Fig. S11b), peaks appear at m/z = 118.83, 154.9 which are identified as succinic acid and benzene sulfonic acid, respectively. Other peaks with very less relative abundance were observed in spectra at m/z = 217, 201.08, 175, 141, and 121 which could be ascribed to the products mentioned in Table 1 and their corresponding chromatograms are shown in Fig. S12. The peak at m/z = 58.83 (Fig. S11) appears in both spectra and corresponds to acetic acid. The data corroborates with the literature reports.¹⁻⁶ This indicates that degradation of MO leads to formation of short chain carboxylic acid along with other small organic molecules which can be further degraded to CO₂ and H₂O.^{3,6}

Fig S11: Full-scan mass spectrogram corresponding to (a) the MO solution before and (b) after degradation. Each peak is characterized by its m/z value.

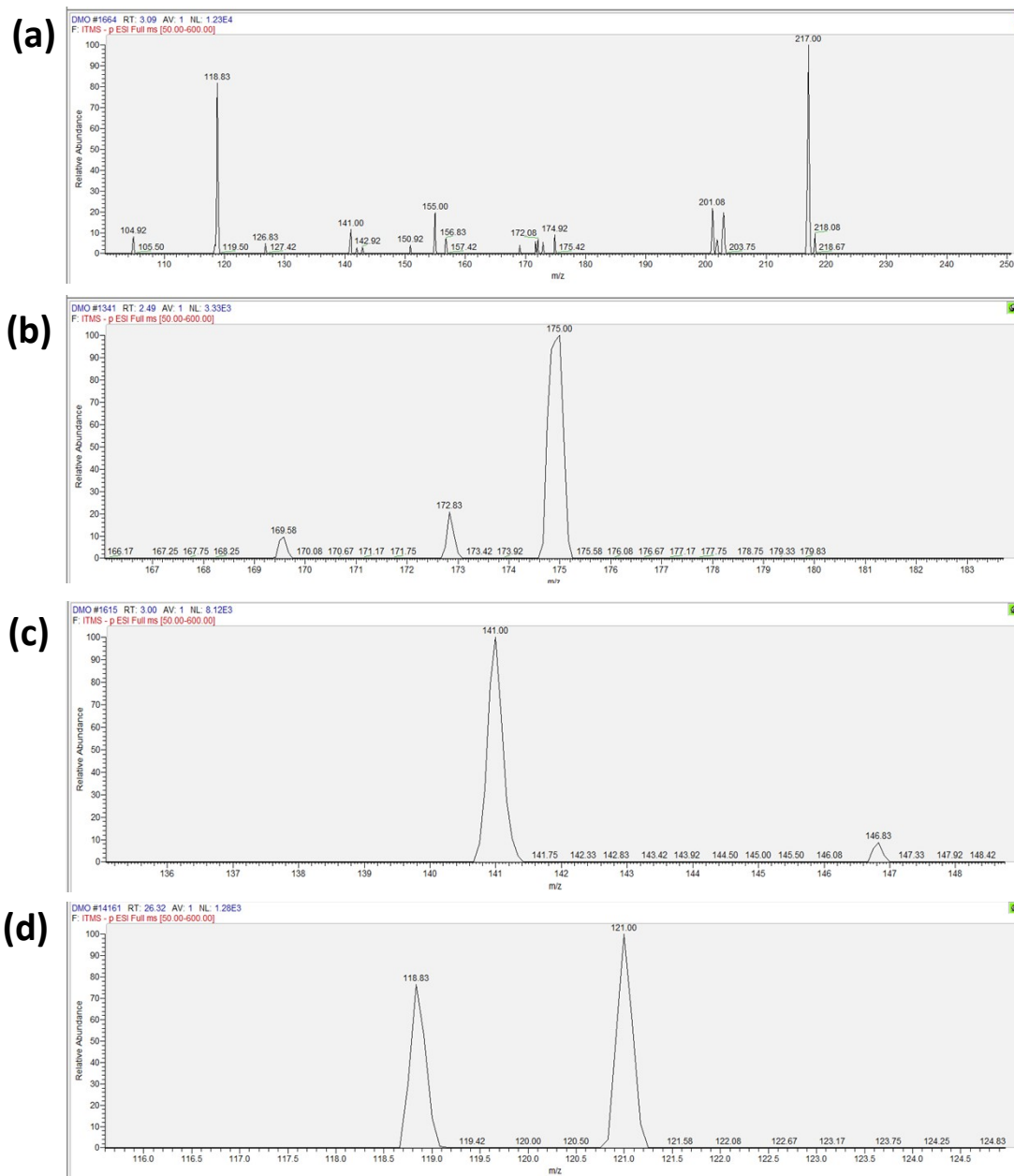
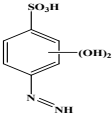
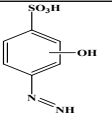
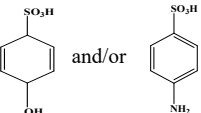
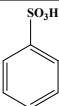
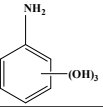
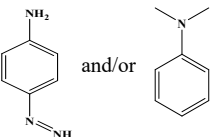
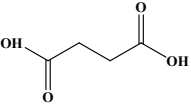


Figure S12. Mass spectrograms corresponding to the MO solution after degradation with m/z at (a) 201.08, 217 (b) 175 (c) 141 (d) 121.

Table 1. Products of degradation of methyl orange dye catalyzed by Ag_3Sn

m/z	products
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217.00	
201.00	
175.00	
154.90	
141.00	
121.00	
118.83	

Methylene blue (MB): The peak at $m/z = 284.2$ (Fig. S13a) is ascribed to parent molecule of MB in mass spectrogram before degradation. The full mass spectrogram after degradation of MB displayed peaks with very low relative abundance of all the peaks (Fig. S13b). This could be due to poor concentration of the products present in reaction mixture. In addition, sample volume of the instrument used is limited to 20 μL . The peaks appeared at $m/z = 247.17, 178.08, 156.06, 118$ could be identified as the products mentioned in Table 2 with their corresponding mass spectrograms shown in Figure S14. The products formed are reported in literature.^{3,6,7,8}

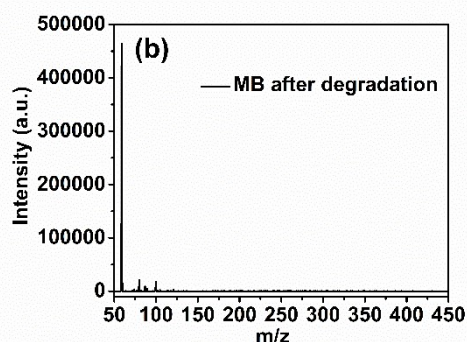
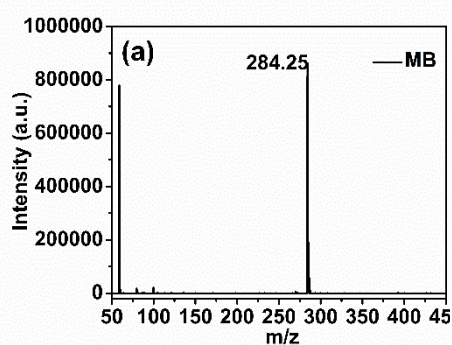


Fig S13. Full-scan mass spectrogram corresponding to (a) the MB solution before and (b) after degradation. Each peak is characterized by its m/z value.

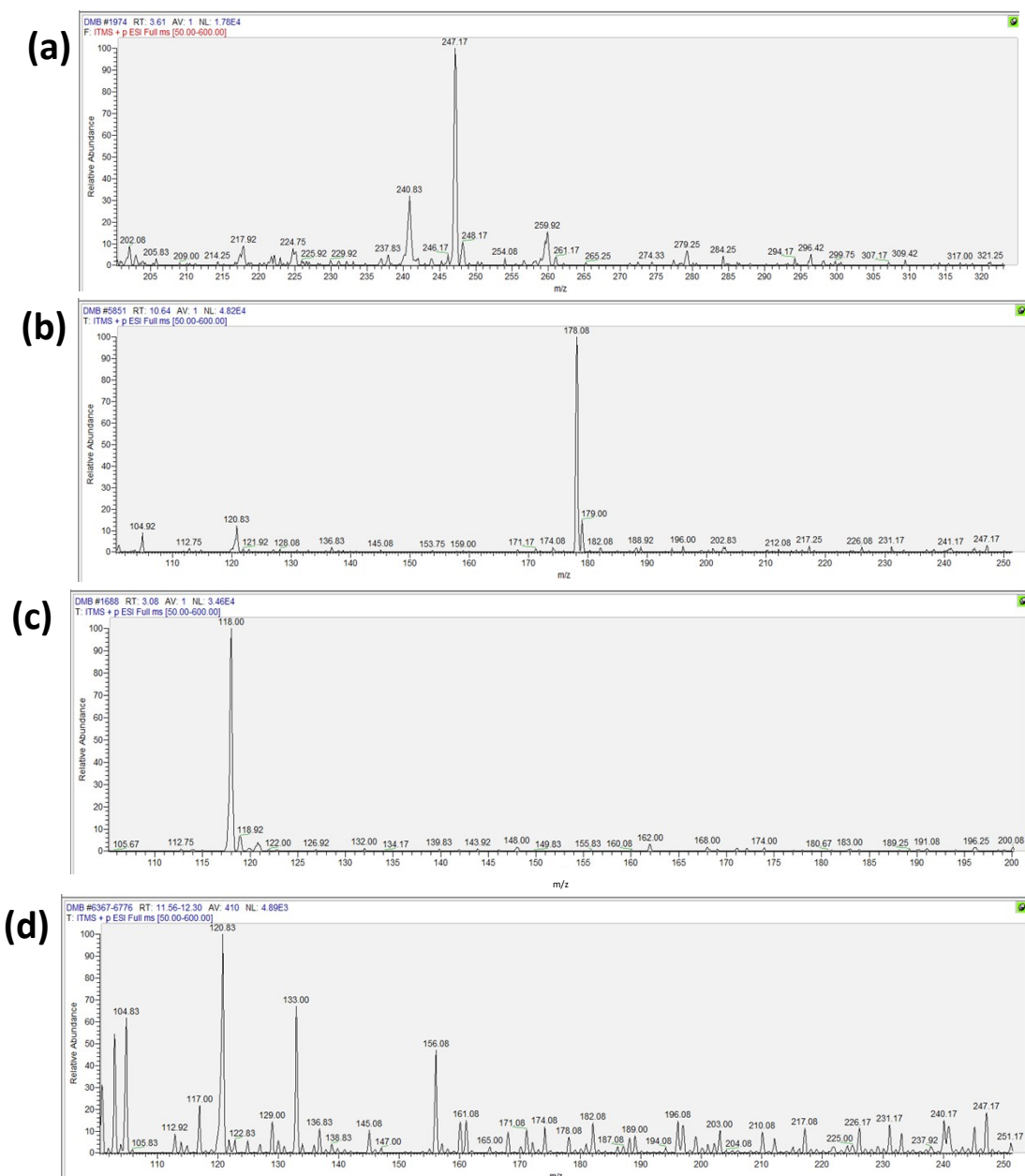
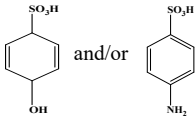
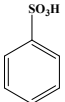
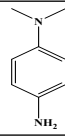
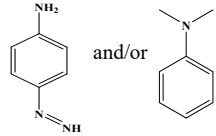
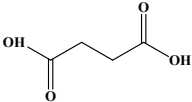


Fig. S14 Mass spectrograms corresponding to the MB solution after degradation with m/z at (a) 247.17 (b) 178.08 (c) 118 (d) 120.83, 156.06

Table 2. Products of degradation of methylene blue dye using Ag₃Sn as a catalyst.

m/z	products
247.17	

178.08	
156.06	
133.00	
120.83	
118.00	

Some of the above products have already been shown to be less toxic compared to the methyl orange and methylene blue dyes themselves as reported in the literature.⁸⁻¹⁰

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