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Comparative study of $BiVO_4$ and $BiVO_4/Ag_2O$ on their properties and photocatalytic degradation mechanism

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Supplementary Experimental Section:

2.1.1 Synthesis of $BiVO_4$

$BiVO_4$ particles were synthesized by the solvothermal method. $Bi(NO_3)_3 \cdot 5H_2O$ (1.8 g) was dissolved into the mixture solution of HNO_3 (1.8 mL) and 1,3-PDO (15 mL). NH_4VO_3 (0.4 g) was dissolved into NaOH (2 mol/L, 15 mL) solution. Then, the NH_4VO_3 solution was slowly dropped into $Bi(NO_3)_3$ solution. The pH of the mixture solution was adjusted to 7. The resulting mixture was transferred into teflon-lined autoclave and heated at 180℃ for 12 h. Subsequently, the mixture was then centrifuged, washed with water/methanol solution, and dried at 60℃ for 8 h. Finally, the solids were calcined at 450 °C for 1 h to obtain the final $BiVO_4$ product.

2.2 Photocatalytic experiment

$BiVO_4$ or $BiVO_4/Ag_2O$ (50 mg) was added to 18 mg/L DC solution (250 mL). The solution was stirred in the darkness for 30 minutes and then exposed to visible light. A certain volume of solution (1 mL) was taken out at the set time and then passed through 0.22 μm filters. The residual DC concentration was detected by ultra-performance liquid chromatography (UPLC) at a wavelength of 345 nm. The solar illumination was simulated by using Xenon lamp (PLS-SXE300 Perfectlight), and visible light was obtained through a cutoff filter. The actual wavelength range was 420 nm to 780 nm. The degradation intermediates of DC were measured by UPLC-QTOF (agilent).

2.3 Characterization of $BiVO_4$ and $BiVO_4$@Ag_2O particles

The crystalline phases of $BiVO_4$ and $BiVO_4$@Ag_2O particles were analyzed by XRD (D8 Advance, Bruker, Germany). The surface chemical composition and

chemical states of the samples was performed by XPS (Escalab 250Xi ThermoFisher). The morphology and particle sizes of the samples were observed by SEM (Sigma 500, Zeiss, Germany). UV-vis DRS was recorded on a Shimadzu UV-2550 spectrometer. The photogenerated electron-hole formation and separation of solid semiconductor materials were analyzed through the SS-SPS technique. The SS-SPS measurements of the samples were carried out with a home-built apparatus, equipped with a lock-in amplier (SR830) synchronized with a light chopper (SR540).

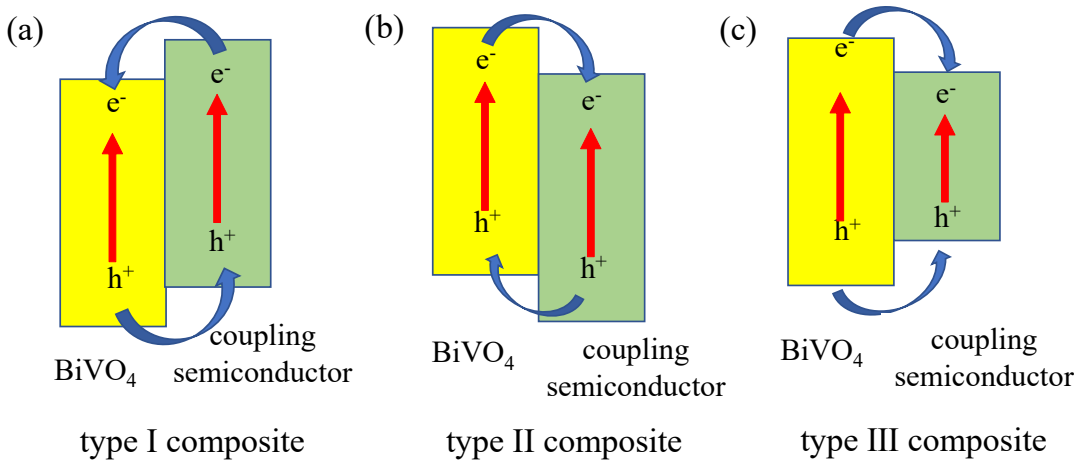
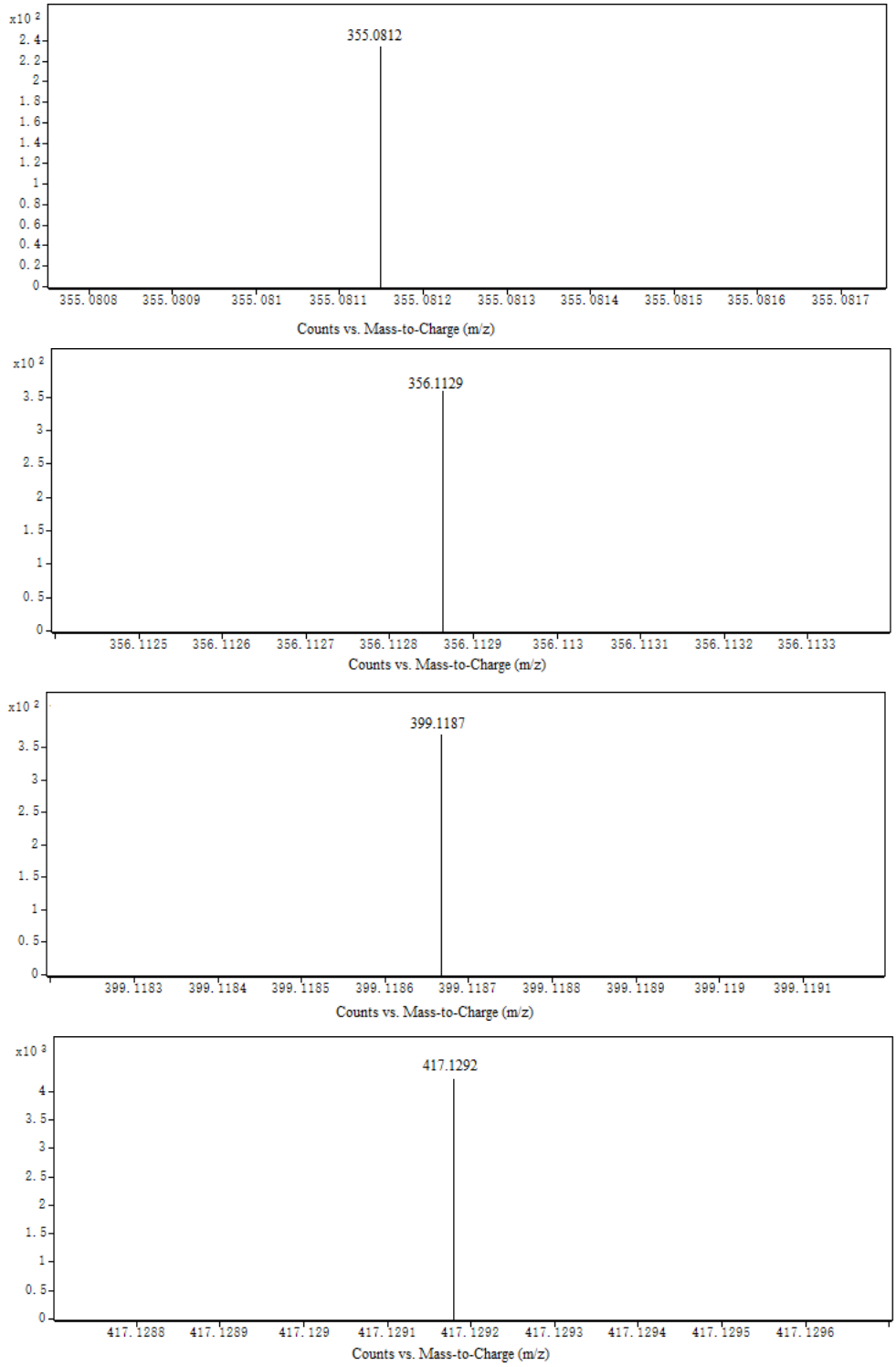
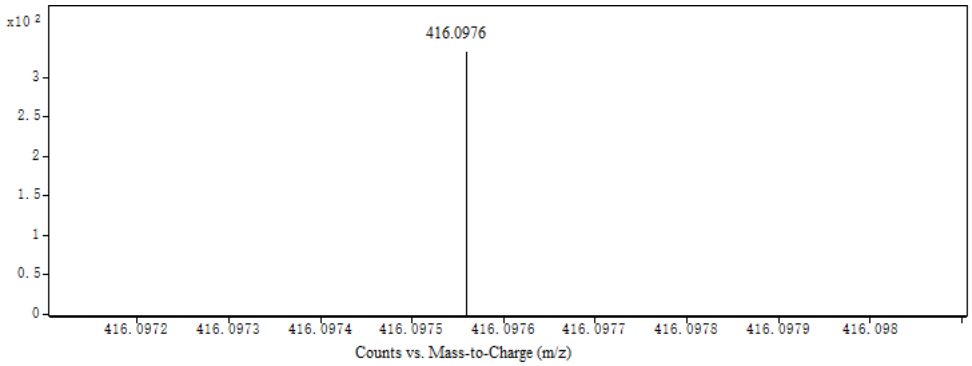


Fig. S1. Separation mechanism of $BiVO_4$ composites

Fig. S2. MS spectra of intermediates during the degradation of DC

(1) The intermediates in photocatalytic $BiVO_4$ system

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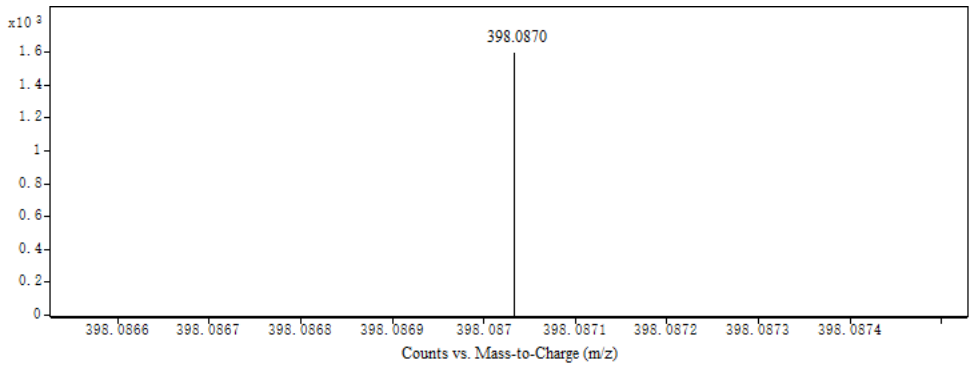
Counts vs. Mass-to-Charge (m/z)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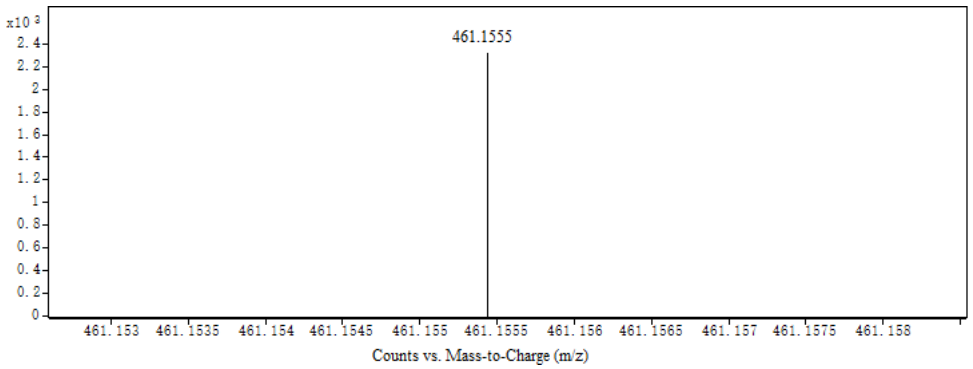
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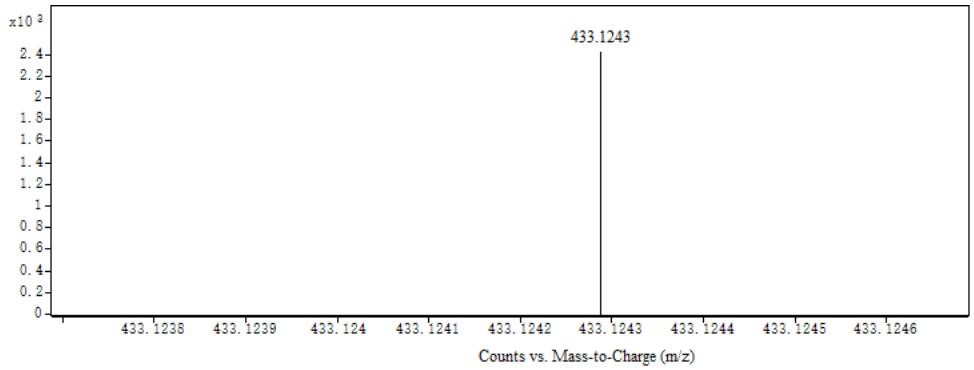
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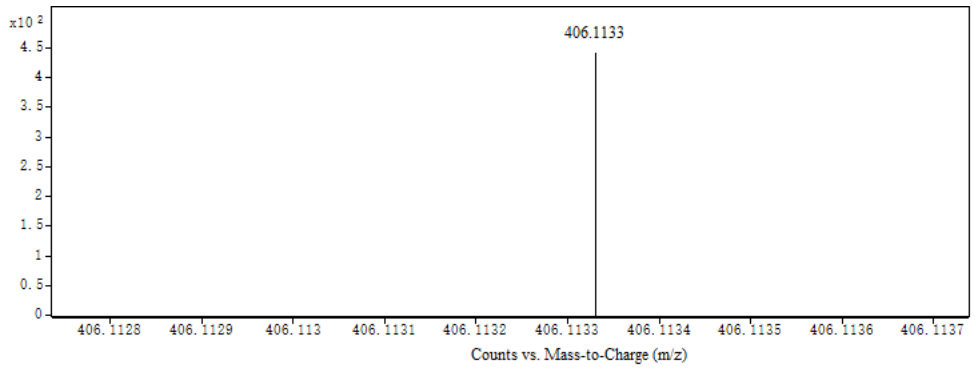
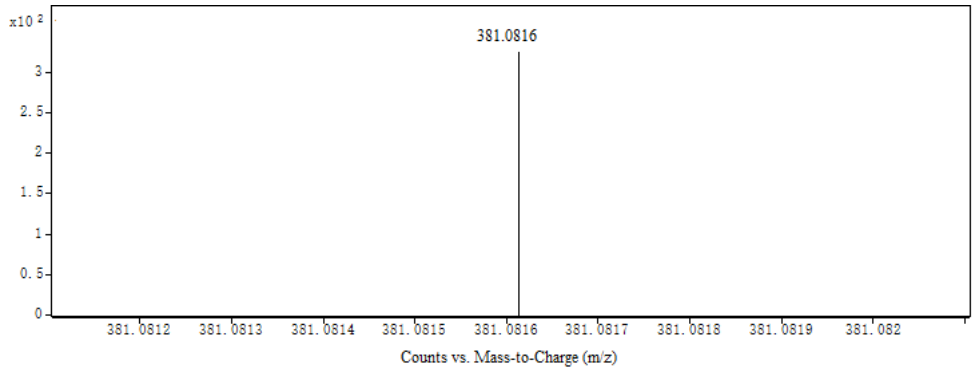
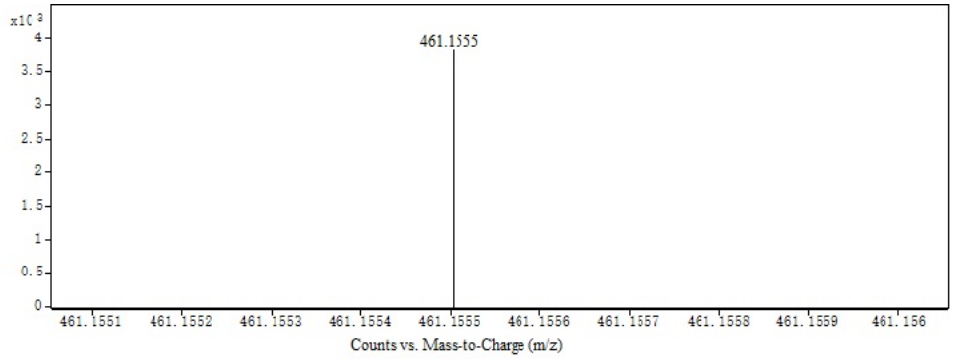
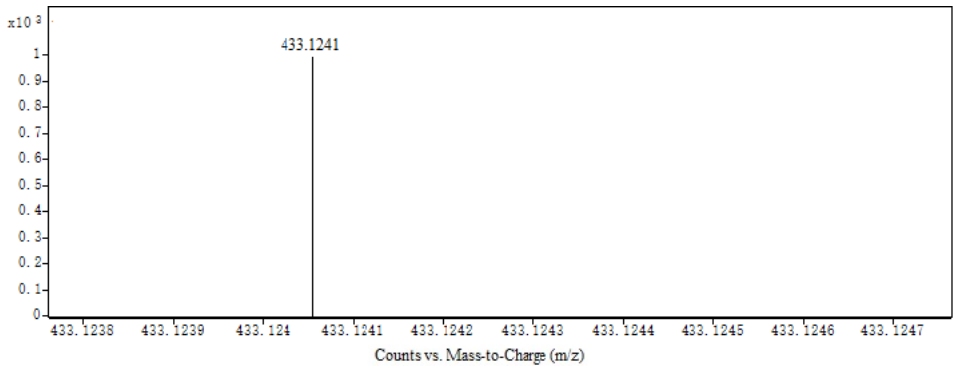
Counts vs. Mass-to-Charge (m/z)

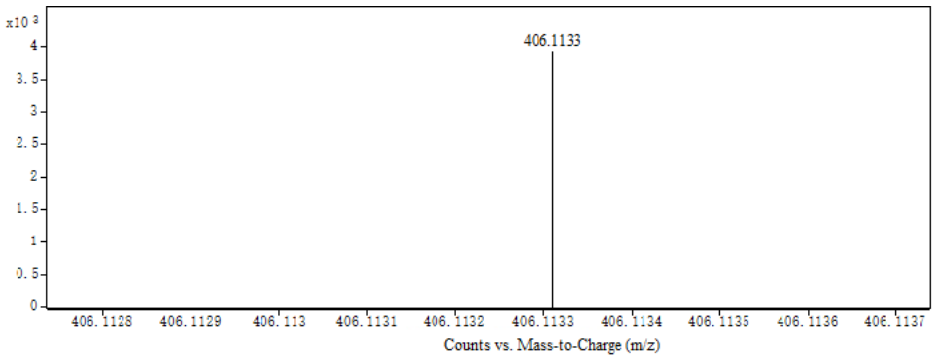




(2) The intermediates in photocatalytic $BiVO_4/Ag_2O$ system



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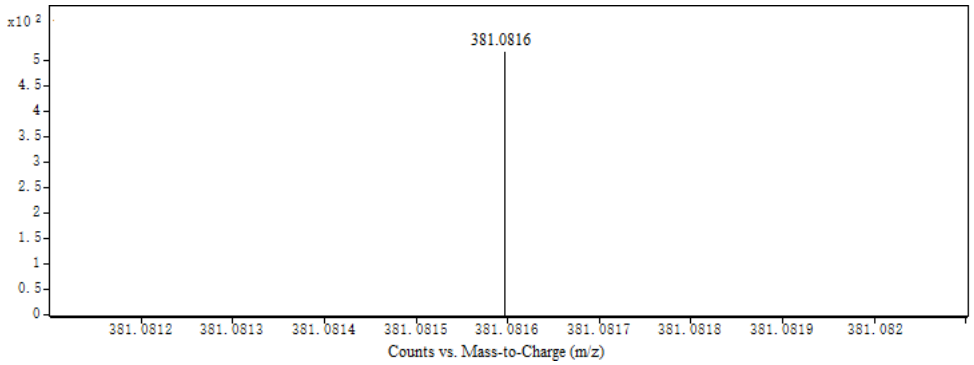
406.1137
Counts vs. Mass-to-Charge (m/z)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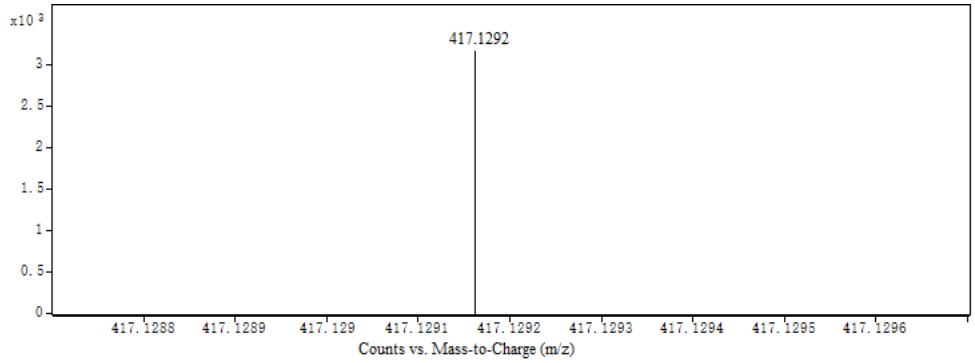
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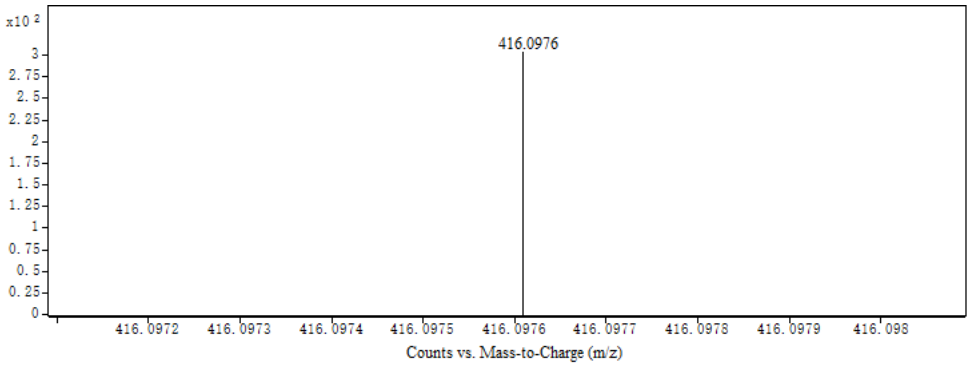
Counts vs. Mass-to-Charge (m/z)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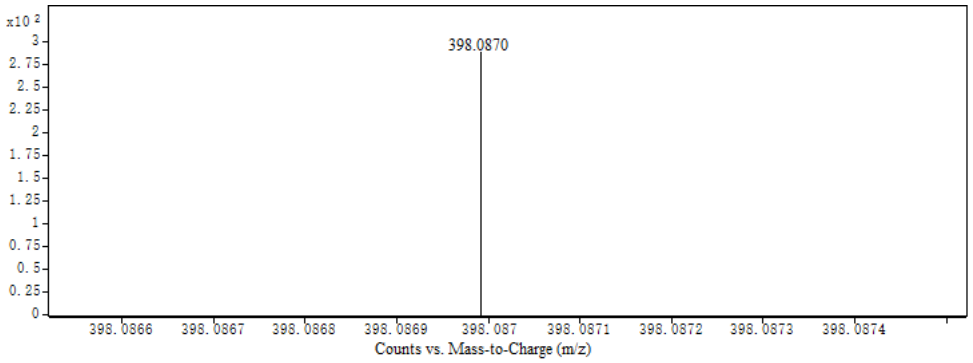
Counts vs. Mass-to-Charge (m/z)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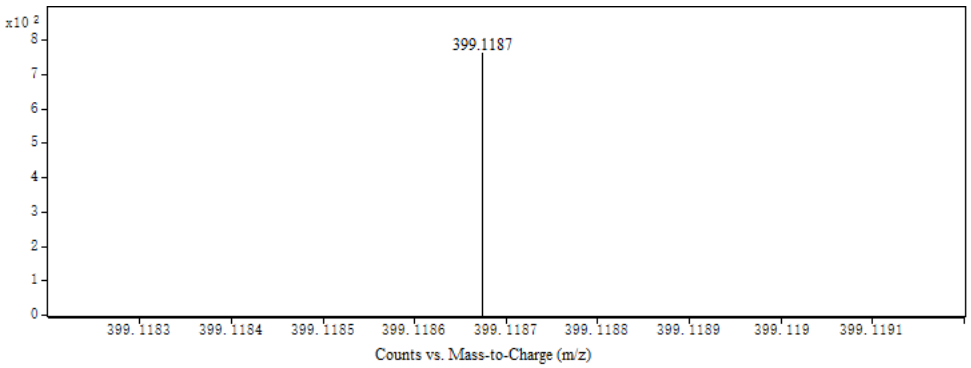
Counts vs. Mass-to-Charge (m/z)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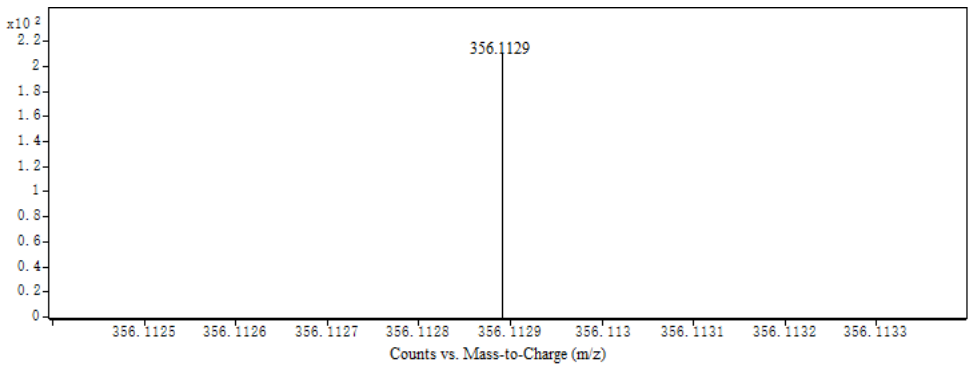
Counts vs. Mass-to-Charge (m/z)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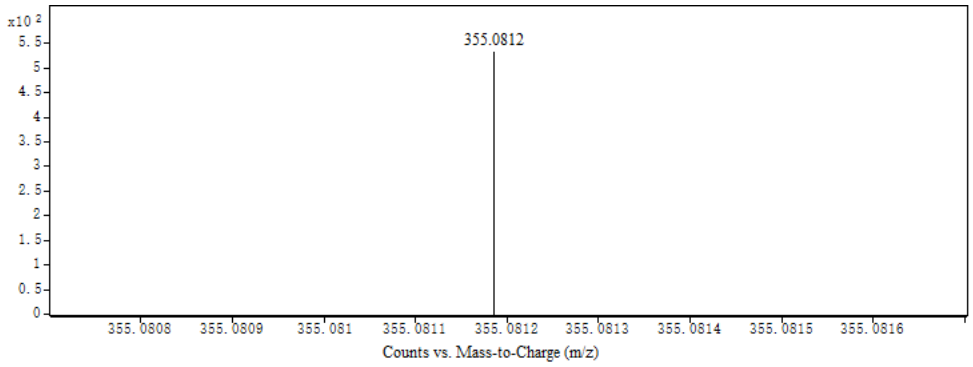
Counts vs. Mass-to-Charge (m/z)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355.0814
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355.0816
Counts vs. Mass-to-Charge (m/z)

Table. S1-1 Identified intermediates of DC degradation in photocatalytic $BiVO_4$ system and photocatalytic $BiVO_4$@Ag_2O system

Catalyst	Molecular formula	Theoretical value (m/z) [M+H]	Actual value (m/z) [M+H]	Error (ppm)
$BiVO_4$	$C_{20}H_{20}N_2O_8$	417.1292	417.1292	0.0
	$C_{20}H_{17}NO_9$	416.0976	416.0976	0.0
	$C_{20}H_{15}NO_8$	398.0870	398.0870	0.0
	$C_{20}H_{18}N_2O_7$	399.1187	399.1187	0.0
	$C_{19}H_{17}NO_6$	356.1129	356.1129	0.0
	$C_{19}H_{14}O_7$	355.0812	355.0812	0.0
	$C_{22}H_{24}N_2O_9$	461.1555	461.1555	0.0
	$C_{20}H_{20}N_2O_9$	433.1242	433.1243	0.2
	$C_{19}H_{19}NO_9$	406.1133	406.1133	0.0
	$C_{17}H_{16}O_{10}$	381.0816	381.0816	0.0
$BiVO_4$@Ag_2O	$C_{20}H_{20}N_2O_8$	417.1292	417.1292	0.0
	$C_{20}H_{17}NO_9$	416.0976	416.0976	0.0
	$C_{20}H_{15}NO_8$	398.0870	398.0870	0.0
	$C_{20}H_{18}N_2O_7$	399.1187	399.1187	0.0
	$C_{19}H_{17}NO_6$	356.1129	356.1129	0.0
	$C_{19}H_{14}O_7$	355.0812	355.0812	0.0
	$C_{22}H_{24}N_2O_9$	461.1555	461.1555	0.0
	$C_{20}H_{20}N_2O_9$	433.1242	433.1241	-0.2
	$C_{19}H_{19}NO_9$	406.1133	406.1133	0.0
	$C_{17}H_{16}O_{10}$	381.0816	381.0816	0.0