Electronic supplementary material

Hydrothermal *in-situ* construction of $AgVO_3/LaVO_4$ phase junctions for the efficient visible-light-driven pollutants disposal and photoelectrocatalytic methanol oxidation

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As known, $LaVO_4$ crystalline has two polymorphs, that is, tetragonal phase (t) with zircon structure and monoclinic phase (m) with monazite structure.[1] m-LaVO4 has drawn considerable interest because of its surface catalytic properties, and the absorption of visible light. Herein, m-$LaVO_4$ was prepared and applied. m-$LaVO_4$ belongs to the monoclinic structure with group of P21/n(NO. 14). The lattice parameters of m-$LaVO_4$ are a=7.139, b=7.353, c=6.804, β= 105.306°. Every V atom lies in the center of tetrahedron composed by 4 O atoms, every La atom connects with O atoms in 9 tetrahedral VO_4, as shown as Fig. S1.

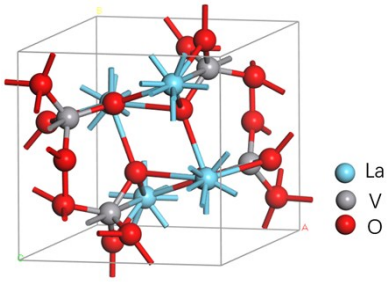

Fig. S1 The structure of m-$LaVO_4$

$AgVO_3$ can be crystallized in four different structures. α-$AgVO_3$, γ-$AgVO_3$ and δ-$AgVO_3$ are metastable and β-$AgVO_3$ is the only one of thermodynamically stable. α-$AgVO_3$ and β-$AgVO_3$ show one-dimensional morphologies, and they can be found in the form of nanowires, nanorods or nanotubes. The α-$AgVO_3$ phase can be irreversibly transformed into β-$AgVO_3$ at temperatures up to 200 °C.[2] β-$AgVO_3$ was obtained in this work and it had monoclinic crystalline system, space group of C_m, and crystallographic parameters are a = 18.106, b = 3.579 , c = 8.043 Å and β= 104.44°,[3] as shown as Fig. S2.

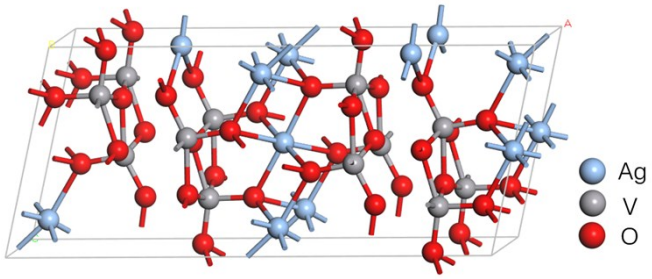

Fig. S2 The structure of β-$AgVO_3$.

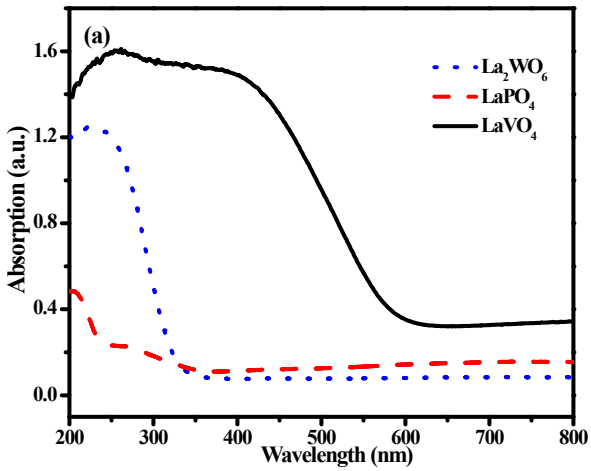

Fig. S3 UV-Vis DRS Spectra of different lanthanum salts.

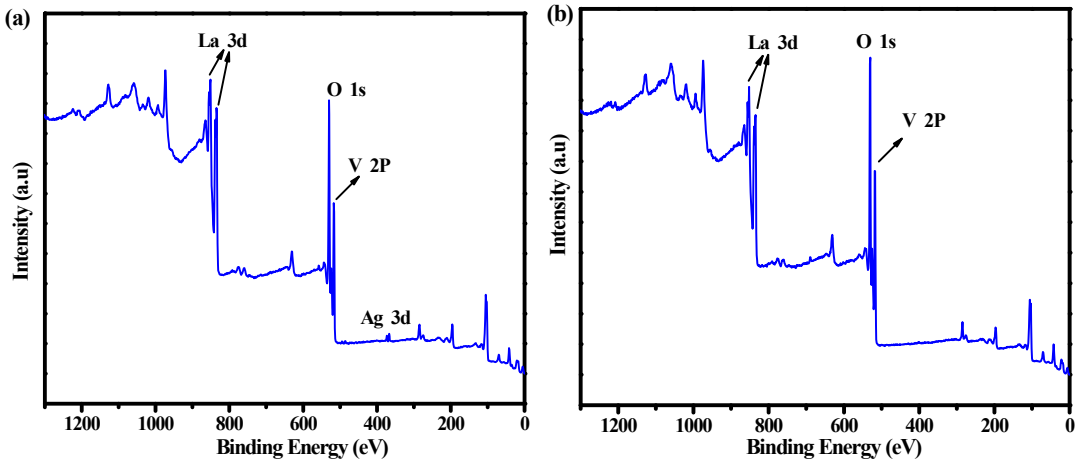

Fig.S4 XPS spectra of $LaVO_4$ and $AgVO_3/LaVO_4$, (a) survey spectrum of $AgVO_3/LaVO_4$; (b) survey spectrum of pure $LaVO_4$.

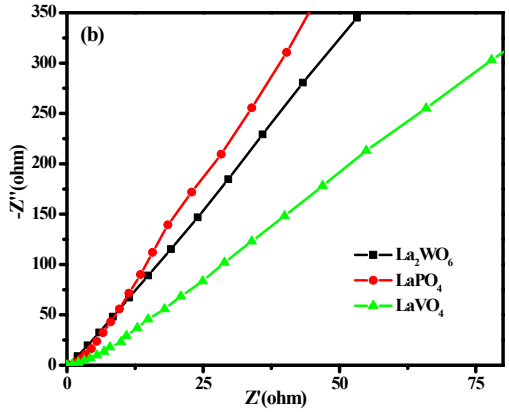

Fig. S5 Electrochemical impedance spectroscopy (EIS) Nyquist plots of different lanthanum salts.

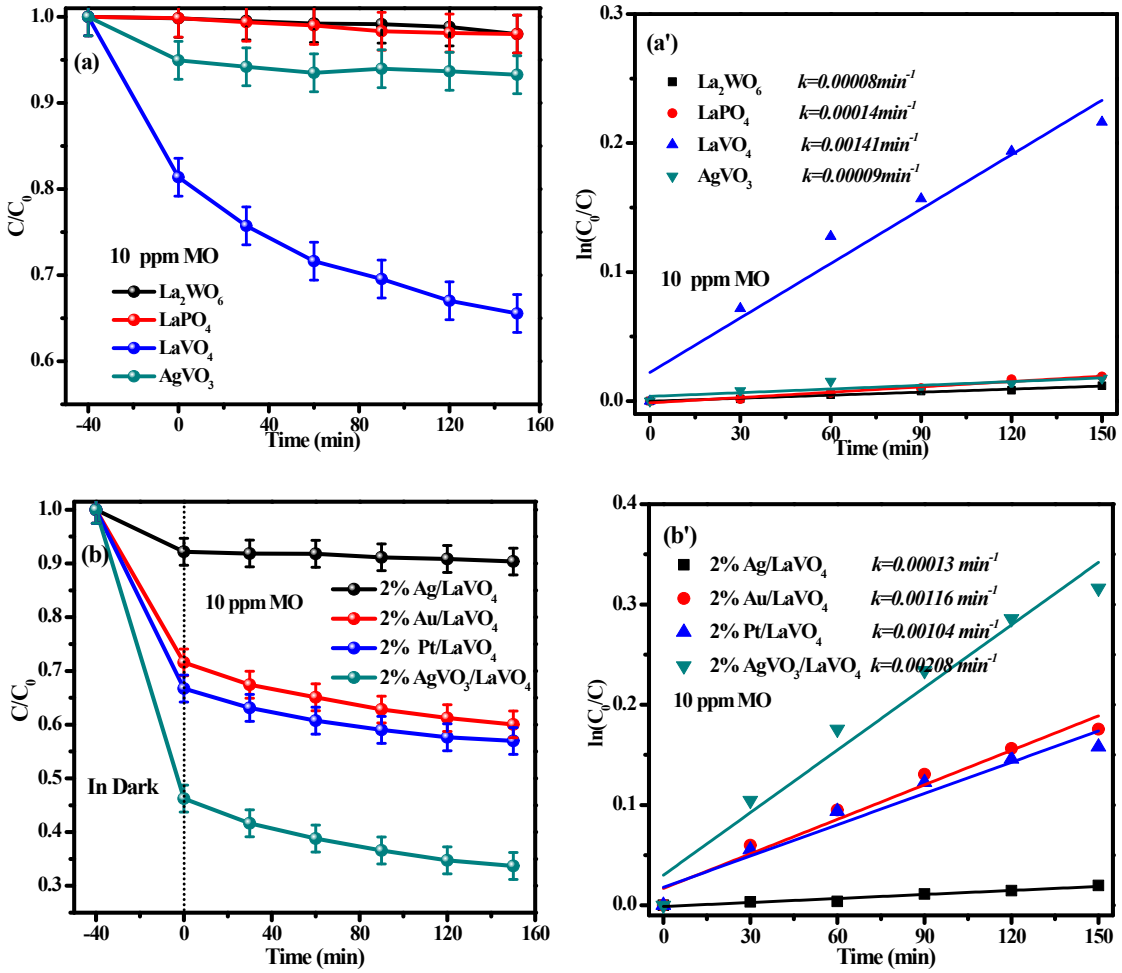

Fig. S6 The degradation and kinetic plots of MO and AO solution with different samples under the visible light irradiation. a and a' correspond to MO degradation of La_2WO_6, $LaPO_4$, $LaVO_4$and $AgVO_3$; b and b' MO degradation of $Au/LaVO_4$, $Ag/LaVO_4$ and $Pt/LaVO_4$ catalysts.

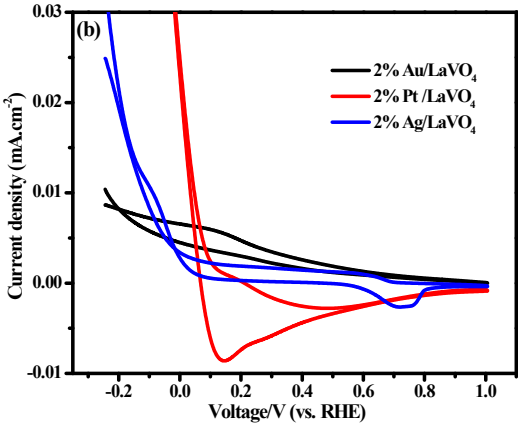

Fig. S7 CV curves over $LaVO_4$ catalysts supported by Au, Pt And Ag nanoparticles under visible light irradiation.

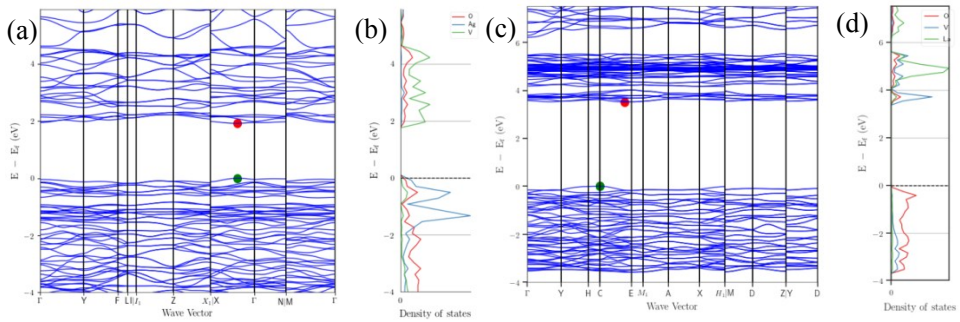

Fig.S8 (a) The projected band structures and (b) PDOS of $AgVO_3$, (c) the projected band structures and (d) PDOS of $LaVO_4$.

References

[1] L. P. Wang, L. M. Chen, *Mater. Charact*., 2012, 69, 108-114.

[2] R. C. Oliveira, M. M. Teixeira, J. P. C. Costa, M. Penha, E. M. Francisco, J. S. da Silva, M. S. Li, E. Longo, L. Gracia, J. Andrés, *Ceram. Int*., 2018, 44, 5939–5944.

[3] A. P. de Melo Monteiro, R. Dias Holtz, L. Carneiro Fonseca, C. H. Zanini Martins, M. de Sousa, L. A. V. de Luna, D. L. de Sousa Maia, O. L. Alves, *Chem. Rev*., 2018, 18, 973–985.