Supporting information for

$Bi_{7.38}Cr_{0.62}O_{12+x}$ crystal as a novel Visible-Light-Active Photocatalyst up to ～650 nm

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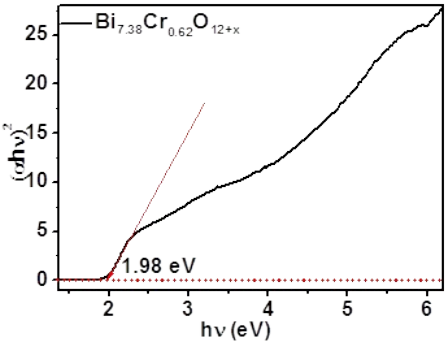

Fig. S1. The plot of transformed Kubelka-Munk function *vs* the energy of $Bi_{7.38}Cr_{0.62}O_{12+x}$ crystal.

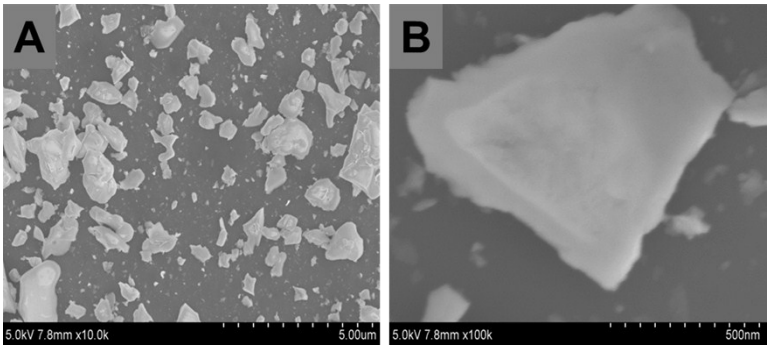

Fig. S2. The FE-SEM images of $Bi_{7.38}Cr_{0.62}O_{12+x}$ crystal.

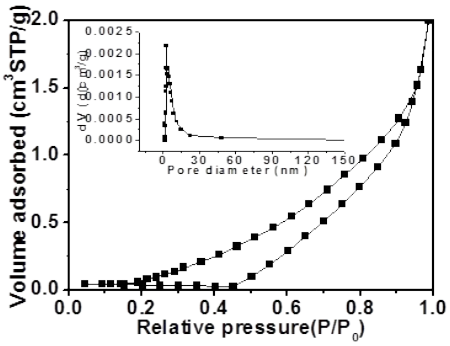

Fig. S3. The N_2 adsorption-desorption curve of $Bi_{7.38}Cr_{0.62}O_{12+x}$ crystal. Inset is the pore size distribution curve.

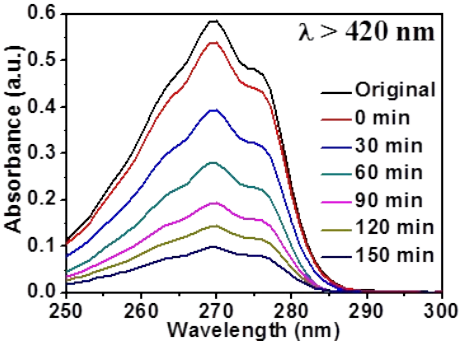

Fig. S4. The photocatalytic degradation (λ > 420 nm) of phenol for $Bi_{7.38}Cr_{0.62}O_{12+x}$ crystal.

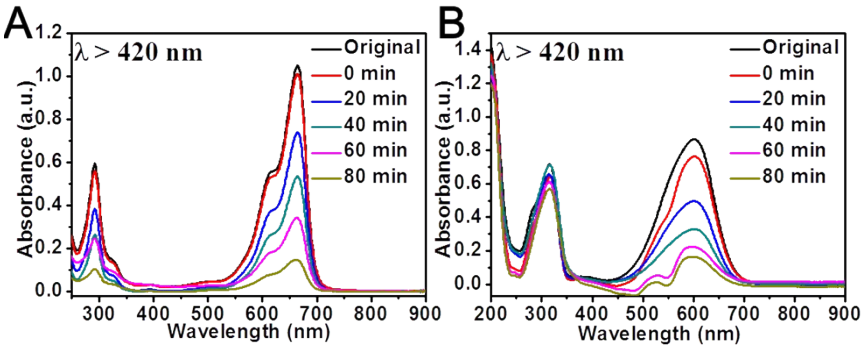

Fig. S5. The photocatalytic degradation (λ > 420 nm) of methylene blue (A) and methyl blue (B) for $Bi_{7.38}Cr_{0.62}O_{12+x}$ crystal.

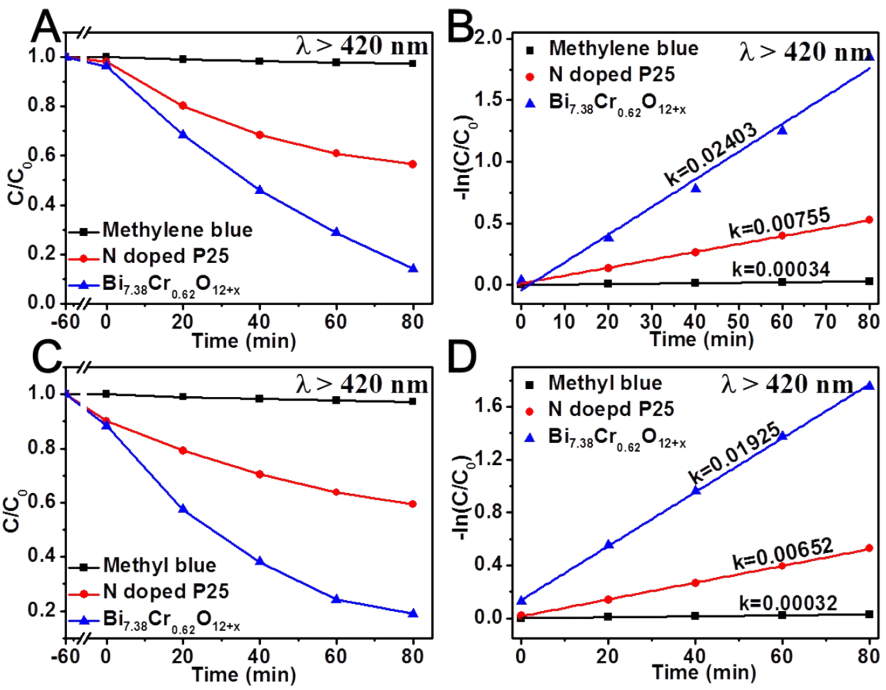

Fig. S6. The photocatalytic degradation (λ > 420 nm) of methylene blue (A, B) and methyl blue (C, D) for N doped P25 and $Bi_{7.38}Cr_{0.62}O_{12+x}$ crystal.

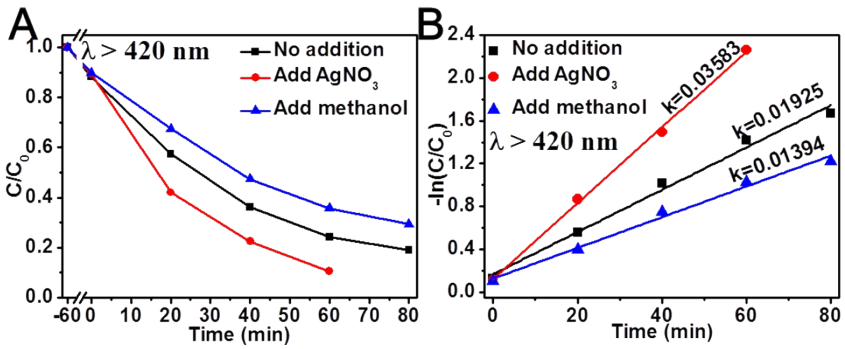

Fig. S7. The photocatalytic degradation (λ > 420 nm) of methyl blue (A and B) by the addition of 100 mg of $AgNO_3$ (electrons scavenger) and 5 mL of methanol (holes scavenger), respectively.

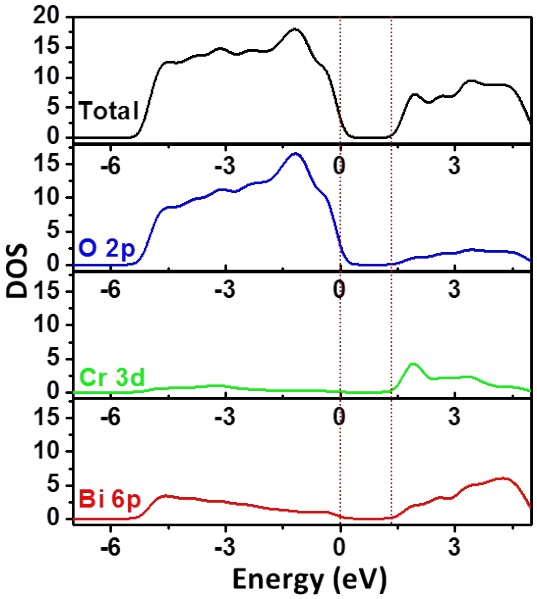

Fig. S8. The calculated density of state (DOS) of $Bi_{7.38}Cr_{0.62}O_{12+x}$ was carried out by using the periodic density functional theory package of Cambridge Serial Total Energy Package (CASTEP) codes.

Calculation Method:

In this work, all of the calculations were carried out using the periodic density functional theory package of Cambridge Serial Total Energy Package (CASTEP) codes. CASTEP is a state-of-the-art quantum mechanics-based program designed specifically for solid-state materials science. The core electrons were treated with the ultrasoft pseudopotential. The exchange-correlation effects of valence electrons were described through the generalized gradient (GGA), within the Perdew-Burke-Ernzerhof (PBE) function. The $Bi_{7.38}Cr_{0.62}O_{12}$ crystal structure was built based on the tetragonal Bi_2O_3, space group P-421 c(114), the 2×2×2 supercell of Bi_2O_3 was built and one Bi atom was replaced by the Cr, which the formula approximate to $Bi_{7.38}Cr_{0.62}O_{12}$. The Monkhorst-Pack scheme *k*-points grid sampling was set as 3×3×3 for the irreducible Brillouin zone. An energy cutoff of 450 eV was used for expanding the Kohn-Sham wave functions. The convergence criteria were set as the force on the atoms less than 0.01 eV $Å^{-1}$, the stress on the atoms less than 0.02 GPa, the atomic displacement less than 5×10^{-4} Å, and the energy change per atom less than 5×10^{-6} eV.