Electronic Supporting Information:

Synthesis of M-doped (M=Ag, Cu, In) Bi_2Te_3 Nanoplates Via Solvothermal Method and Cation Exchange Reaction

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Experimental

Materials

Polyvinylpyrrolidone (PVP) and ethylene glycol(EG) were Gneral Reagent, purchased from Aladdin Ltd. Co.. $BiCl_3$ and K_2TeO_3 were purchased from Macklin Ltd. Co.. NaOH and $AgNO_3$ were purchased from Sinopharm Chemical Reagent Ltd. Co.. $Cu(NO_3)_2{\cdot}2.5H_2O$ were purchased from Alfa Aesar Ltd. Co.. $InCl_3{\cdot}3H_2O$ were purchased from Aladdin Ltd. Co.. All the chemical reagents were used without further purification in the experiments of this study.

Synthesis of Bi_2Te_3 Nanoplates

Bi_2Te_3 nanoplates was synthesized by follow the reported methods.[1] Typically, PVP (0.44 g) and NaOH (0.32 g, 8 mmol) were dissolved in EG at room temperature under stirring. Then, $BiCl_3$（0.8 mmol）and K_2TeO_3（1.2 mmol）were added into the resulted mixture and stirred for around 5h. After obtained a transplant solution, the solution was put into the Teflon-lined autoclave and heated at 180 ºC for 36 hours. Finally, the products were collected and purified by centrifugation and washed with anhydrous ethanol for three times.

Cation Exchange Reactions Involving Ag^+, Cu^{2+}, In^{3+}

A solution of Bi_2Te_3 (0.5mL, ~2.6 μmol) was diluted to 30ml with anhydrous ethanol and ultrasonic dispersing time about 5 minutes. $AgNO_3$ (or $Cu(NO_3)_2{\cdot}2.5H_2O$, or $InCl_3$) solution added into diluted Bi_2Te_3 colloid. The obtained product was collected and purified by centrifugation and washed with anhydrous ethanol.

Structure characterization

To analyze the phases and composition of the sample, X-ray diffraction (XRD) is conducted by using a D8 Advance diffractometer (Bruker, German) with standard Cu/Kα radiation (λ = 1.5406 Å). The scanning speed was 5 º/min. The scanning electron microscope (SEM) images were

collected by using on a ZEISS SUPRA® 55 scanning electron microscope. Low resolution transmission electron microscopy (LRTEM) and high resolution transmission electron microscopy (HRTEM) study were carried out in Tecnai G2 F30, which was equipped with an EDS detector (Oxford X-Max 20). For the sample of Ag-doped and In-doped Bi_2Te_3 nanoplates characterization, the diluted product colloid was dropped onto Cu mesh with carbon-supported films. The Cu-doped Bi_2Te_3 nanoplates colloid was dropped onto Au mesh with carbon-supported films for HRTEM characterization and Element analysis. X-ray photoelectron spectroscopy (XPS) was performed on PHI-5000II VersaProbe II (Ulvac-Phi, Japan).

Figure S1-S2:

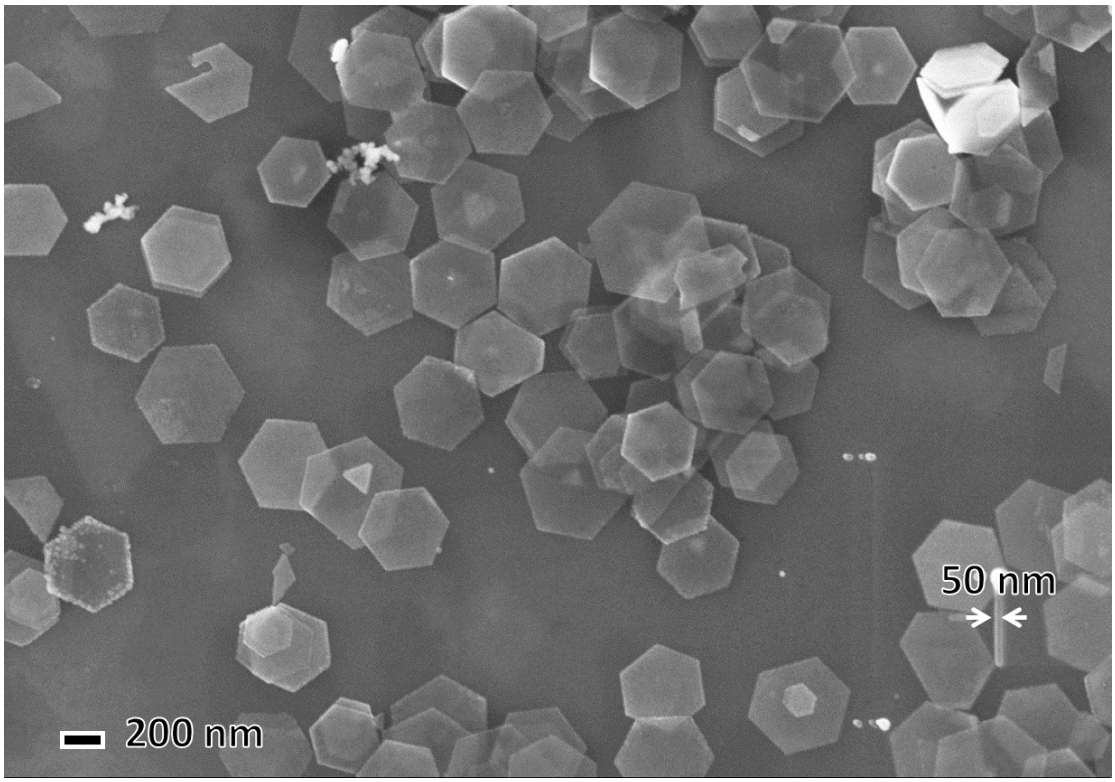

Figure S1. SEM images of as-prepared Bi_2Te_3 nanoplates

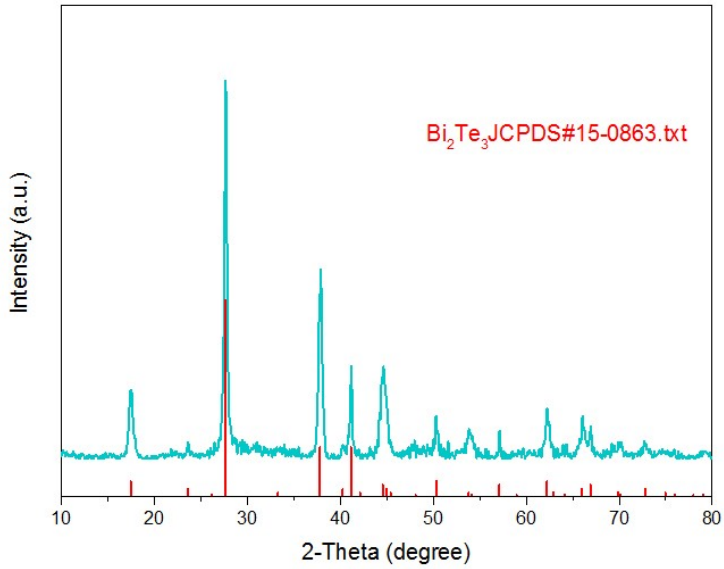

Figure S2. The XRD pattern of as-prepared Bi_2Te_3 nanoplates.

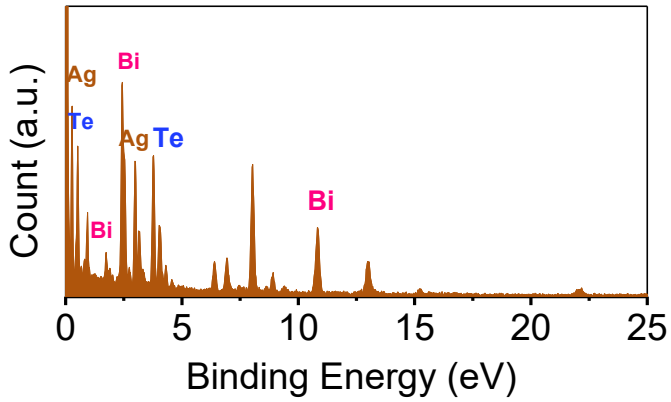

Figure S3 EDS result of as-prepared Ag-doped Bi_2Te_3 nanoplates.

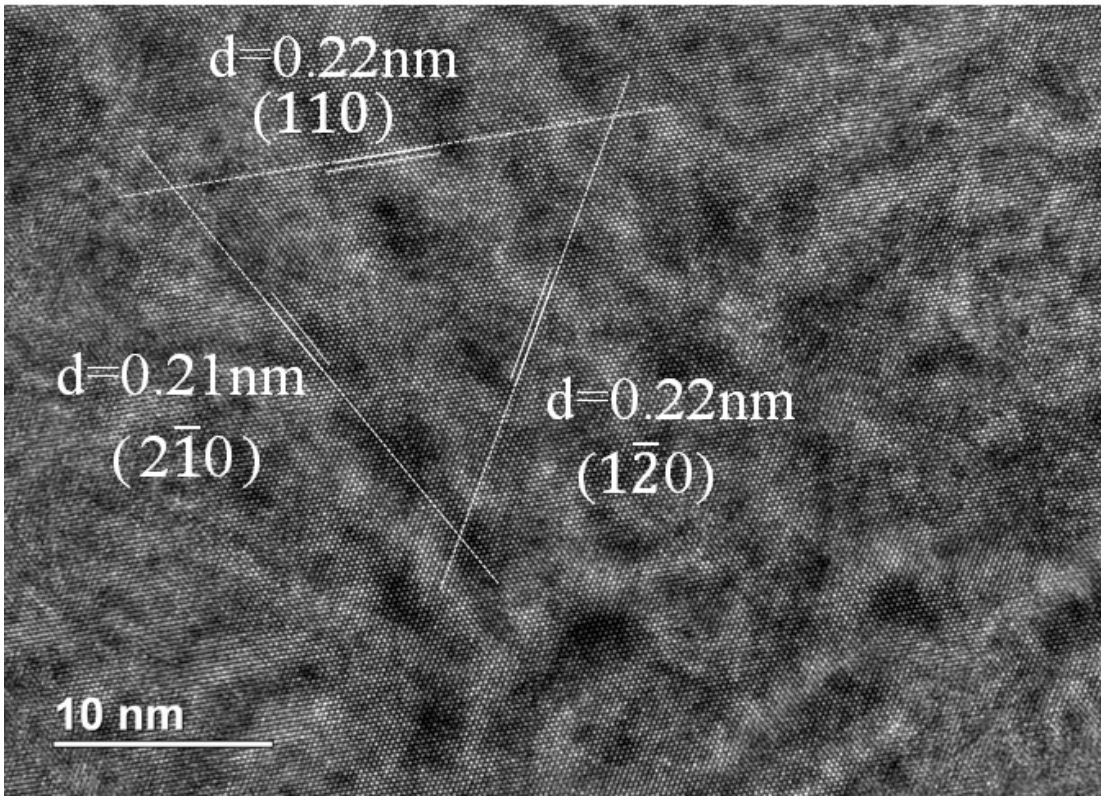

Figure S4. The HRTEM image of as prepared Ag-doped Bi_2Te_3 nanoplates.

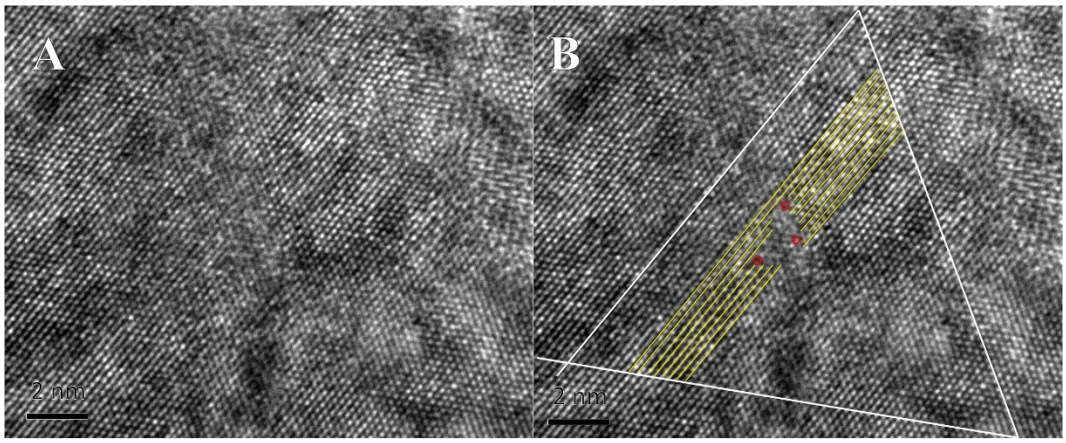

Figure S5. (A) HRTEM image of as-prepared Ag-doped Bi_2Te_3 nanoplates and (B) the lattice distortion by doping of cations.

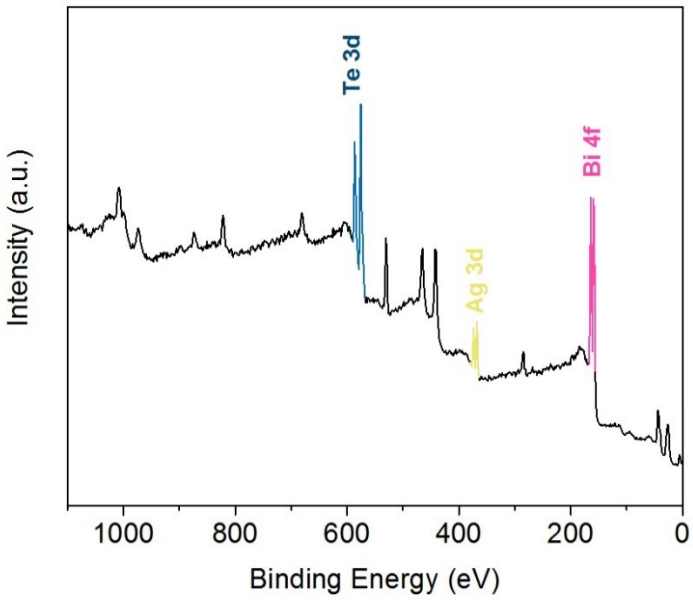

Figure S6. XPS pattern of as-prepared Ag-doped Bi_2Te_3 nanoplates.

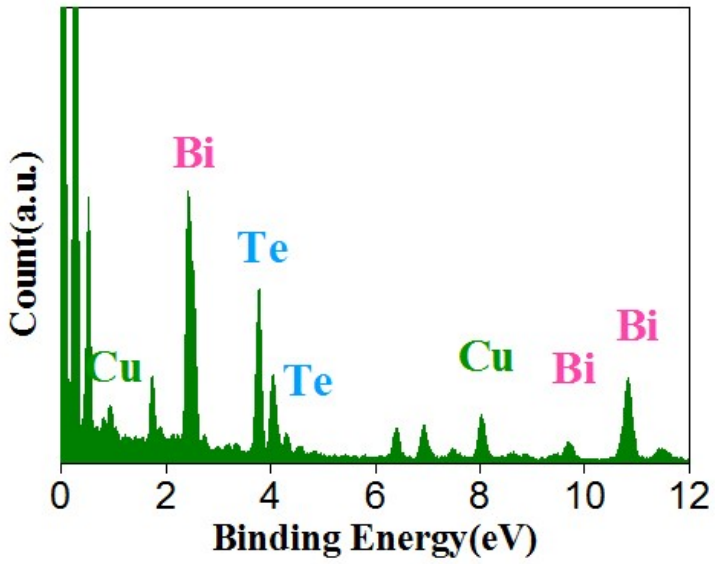

Figure S7 The EDS analysis of as-prepared Cu-doped Bi_2Te_3 nanoplates

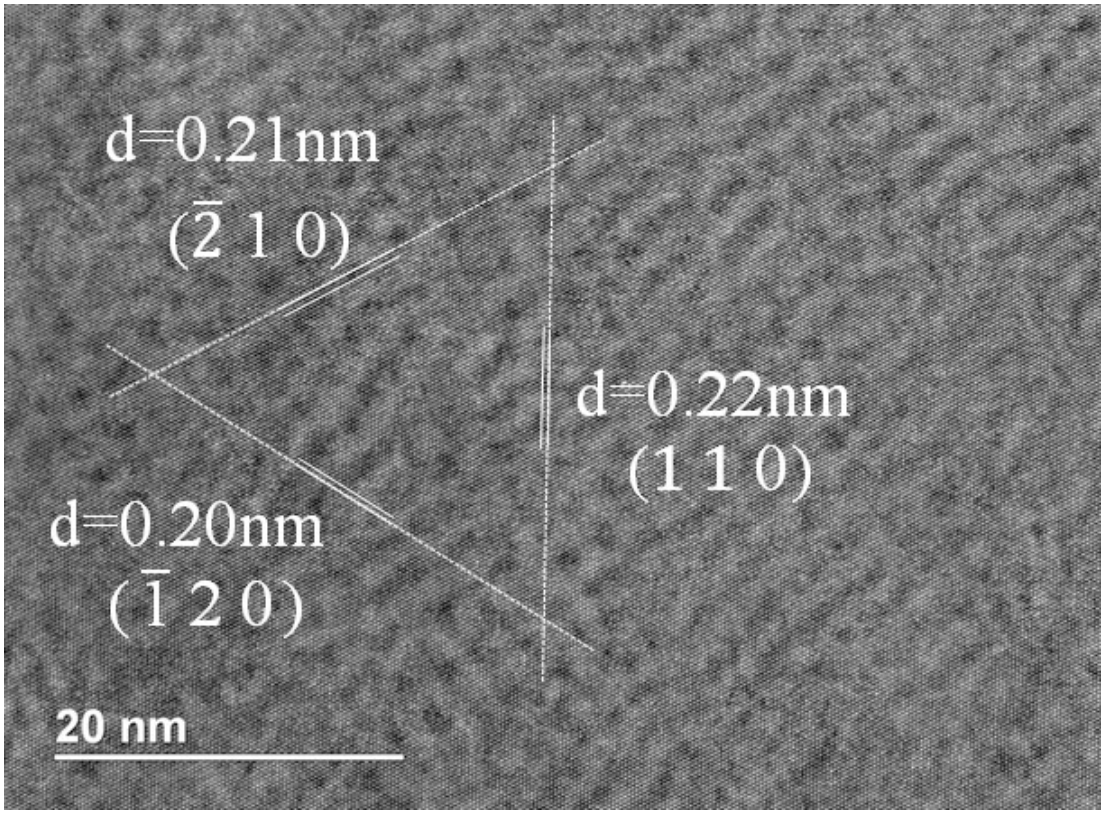

Figure S8. The HRTEM image of as prepared Cu-doped Bi_2Te_3 nanoplates.

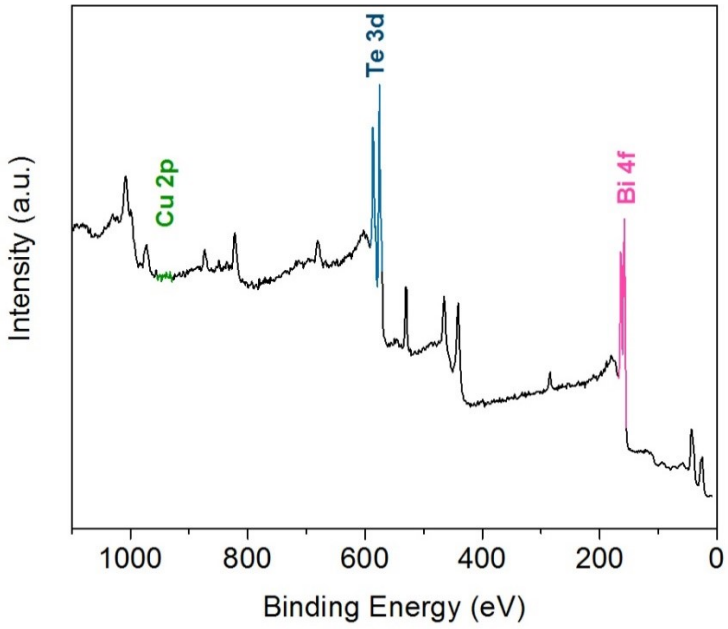

Figure S9. XPS pattern of as-prepared Cu-doped Bi_2Te_3 nanoplates.

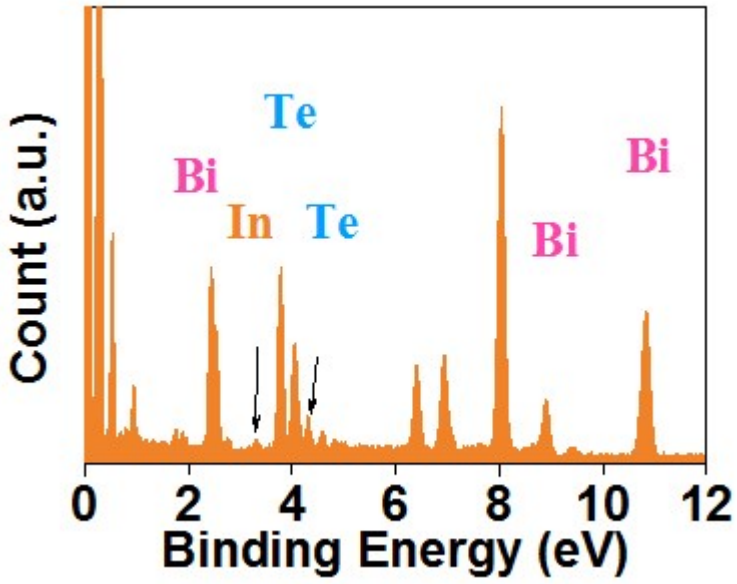

Figure S10. The EDS analysis of as-prepared In-doped Bi_2Te_3 nanoplates.

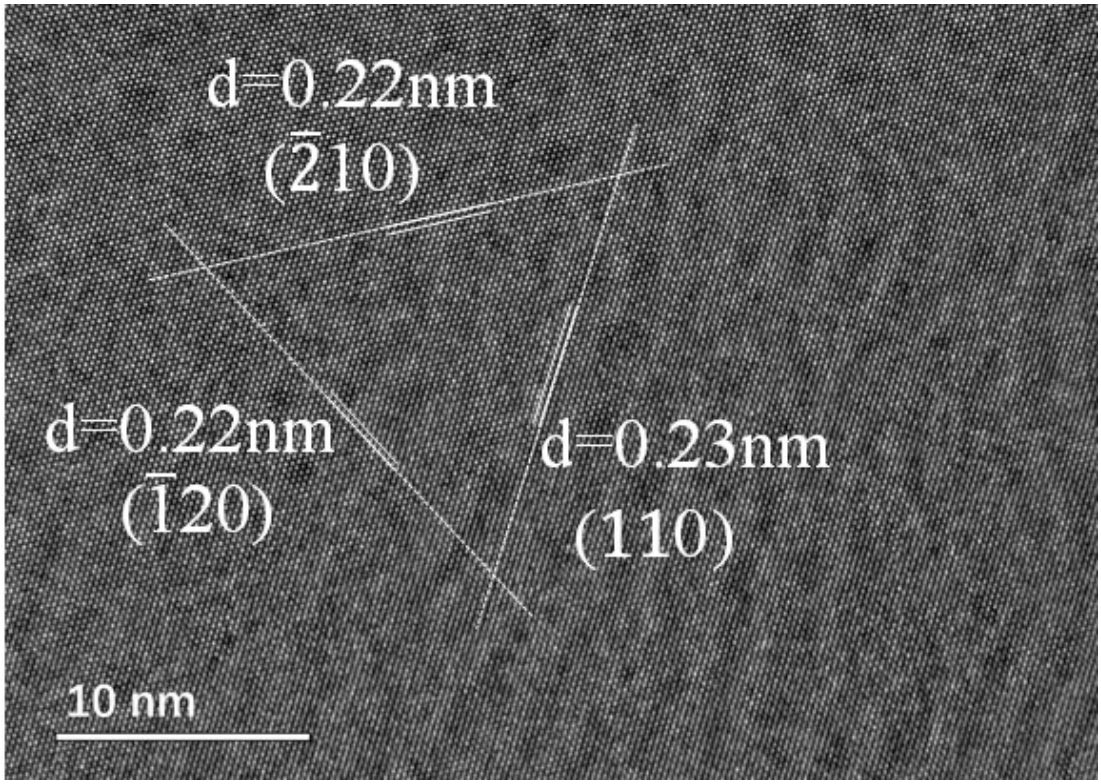

Figure S11. The HRTEM image of as prepared In-doped Bi_2Te_3 nanoplates

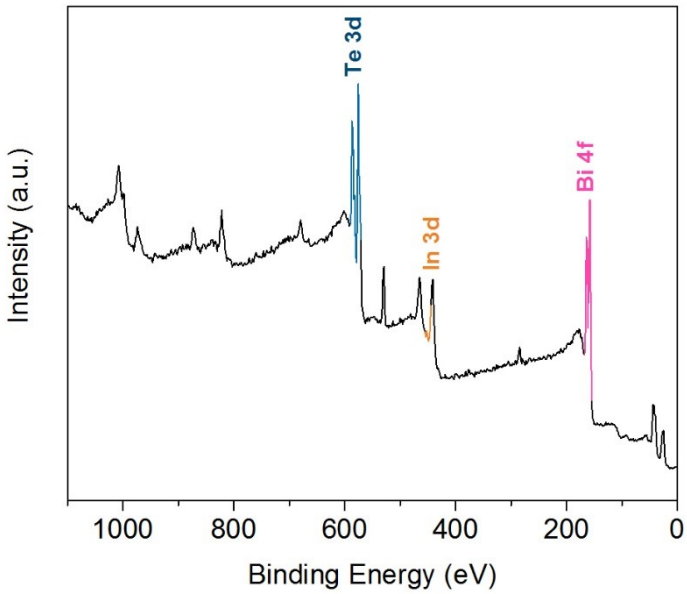

Figure S12. XPS pattern of as-prepared In-doped Bi_2Te_3 nanoplates.

References:

1. Muwei Ji, Meng Xu, Jun Zhang, Jiajia Liu, Jiatao Zhang. Aqueous oxidation reaction enabled layer-by-layer corrosion of semiconductor nanoplates into single-crystalline 2D nanocrystals with single layer accuracy and ionic surface capping. *Chem. Commun.*, 2016, 52, 3426--3429