Electronic Supporting Information:

**Synthesis of M-doped (M=Ag, Cu, In) Bi$_2$Te$_3$ Nanoplates Via Solvothermal Method and Cation Exchange Reaction**

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**Experimental**

**Materials**

Polyvinylpyrrolidone (PVP) and ethylene glycol (EG) were General Reagent, purchased from Aladdin Ltd. Co.. BiCl$_3$ and K$_2$TeO$_3$ were purchased from Macklin Ltd. Co.. NaOH and AgNO$_3$ were purchased from Macklin Ltd. Co.. Cu(NO$_3$)$_2$·2.5H$_2$O were purchased from Alfa Aesar Ltd. Co. InCl$_3$·3H$_2$O were purchased from Aladdin Ltd. Co.. All the chemical reagents were used without further purification in the experiments of this study.

**Synthesis of Bi$_2$Te$_3$ Nanoplates**

Bi$_2$Te$_3$ nanoplates was synthesized by follow the reported methods. 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$_2$TeO$_3$ (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 °C 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$_2$Te$_3$ (0.5mL, ~2.6 μmol) was diluted to 30ml with anhydrous ethanol and ultrasonic dispersing time about 5 minutes. AgNO$_3$ (or Cu(NO$_3$)$_2$·2.5H$_2$O, or InCl$_3$) solution added into diluted Bi$_2$Te$_3$ 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 °/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 Bi₂Te₃ nanoplates characterization, the diluted product colloid was dropped onto Cu mesh with carbon-supported films. The Cu-doped Bi₂Te₃ 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 Bi₂Te₃ nanoplates](image-url)
Figure S2. The XRD pattern of as-prepared Bi$_2$Te$_3$ nanoplates.

Figure S3 EDS result of as-prepared Ag-doped Bi$_2$Te$_3$ nanoplates.
Figure S4. The HRTEM image of as prepared Ag-doped Bi$_2$Te$_3$ nanoplates.

Figure S5. (A) HRTEM image of as-prepared Ag-doped Bi$_2$Te$_3$ nanoplates and (B) the lattice distortion by doping of cations.
Figure S6. XPS pattern of as-prepared Ag-doped Bi$_2$Te$_3$ nanoplates.

Figure S7. The EDS analysis of as-prepared Cu-doped Bi$_2$Te$_3$ nanoplates.
Figure S8. The HRTEM image of as prepared Cu-doped Bi$_2$Te$_3$ nanoplates.

Figure S9. XPS pattern of as-prepared Cu-doped Bi$_2$Te$_3$ nanoplates.
Figure S10. The EDS analysis of as-prepared In-doped Bi$_2$Te$_3$ nanoplates.

Figure S11. The HRTEM image of as prepared In-doped Bi$_2$Te$_3$ nanoplates.
Figure S12. XPS pattern of as-prepared In-doped Bi₂Te₃ nanoplates.

References: