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High thermoelectric performance of In-doped Cu$_2$SnSe$_3$ prepared by fast combustion synthesis

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**Fig. S1** XRD pattern of the monoclinic Cu$_2$SnSe$_3$ prepared by combustion synthesis in air.

**Fig. S2** Photographs of the Cu$_2$Sn$_{0.9}$In$_{0.1}$Se$_3$ sample prepared by high-pressure combustion synthesis in an Ar atmosphere with a pressure of 2 MPa.
Figure S3 XRD patterns of the Cu$_2$Sn$_{1-x}$In$_x$Se$_3$ samples after spark plasma sintering: (a) an overview; (b) an enlarged view to clearly show the small peaks. No significant difference was observed in the XRD patterns of the samples just synthesized and after spark plasma sintering.
Fig. S4 Back-scattered electron images and EDS results of the Cu$_2$Sn$_{1-x}$In$_x$Se$_3$ samples: (a) and (b) prepared by high-pressure combustion synthesis, $x=0.05$, with SnSe as the secondary phase; (c) and (d) prepared by high-pressure combustion synthesis, $x=0.20$, with a Cu-rich secondary phase; (e) and (f) prepared by high-pressure combustion synthesis followed with spark plasma sintering, $x=0.1$, with much more grain boundaries compared with the just synthesized samples before spark plasma sintering.
The lattice thermal conductivities are calculated according to the Wiedemann-Franz Law ($\kappa = \kappa_e + \kappa_L = L_0 \sigma T + \kappa_L$), where $\kappa_e$ is the thermal conductivity contributed by carriers, $L_0$ is the Lorentz number, $\sigma$ is the electrical conductivity, and $T$ is the absolute temperature. In our calculation, the Lorentz number of $L_0 = 2.0 \times 10^{-8}$ WΩK$^{-2}$ is used according to the report by Shi et al. (X. Shi, L. Xi, J. Fan, W. Zhang and L. Chen, Chemistry of Materials, 2010, 22, 6029-6031.)