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Supplementary information

New frontier in printed thermoelectrics: Formation of β-Ag_2Se through thermally stimulated dissociative adsorption leads to high ZT

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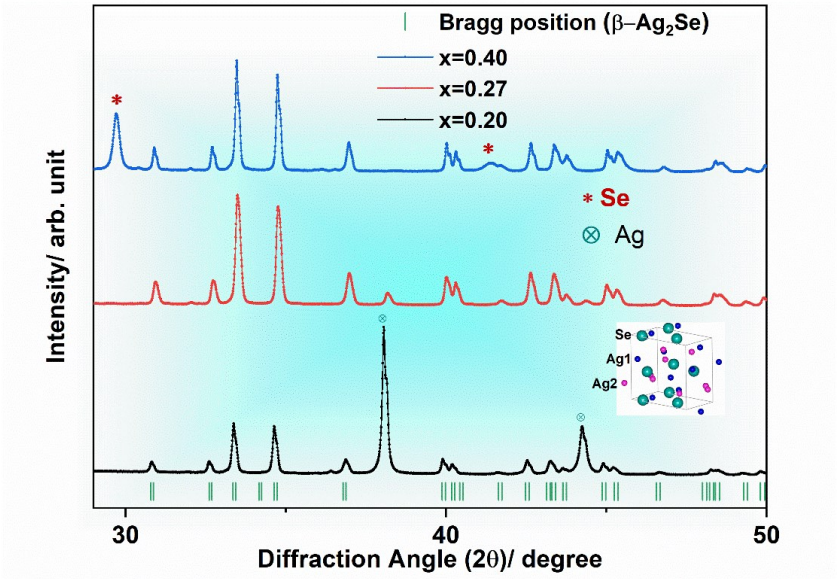

Fig. S1: The room temperature XRD patterns of the printed films (1-x)Ag-xSe for x=0.20, 0.27 and 0.40, sintered at 473 K indicate the presence of orthorhombic β-Ag_2Se phase along with a small fraction of excess Ag or Se.

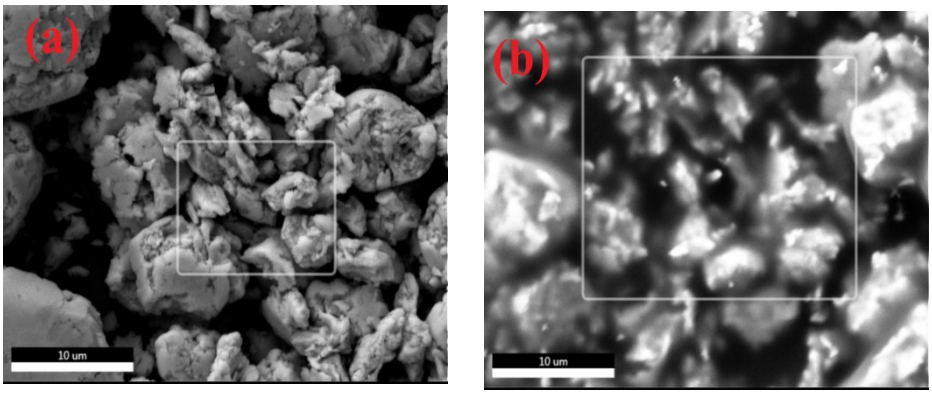

Fig. S2: EDS analysis results for both the non-sintered (a) and sintered (b) films for x=0.27 are given in the table.

Table S1: Wt % and At % of Ag and Se in the

Ag_2Se phase using EDS analysis

Elements	Non-sintered/Fig. (a)		Sintered/Fig. (b)	
	Weight %	Atomic %	Weight %	Atomic %
Ag	68.21	61.10	75.59	69.39
Se	31.79	38.90	24.41	30.61

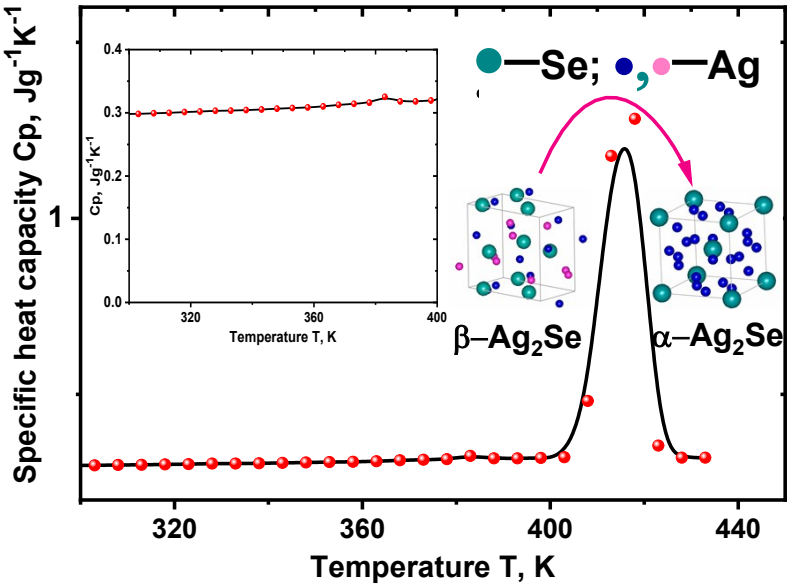

Fig. S3: The temperature dependent specific heat capacity (C_P) of the ink for x=0.27

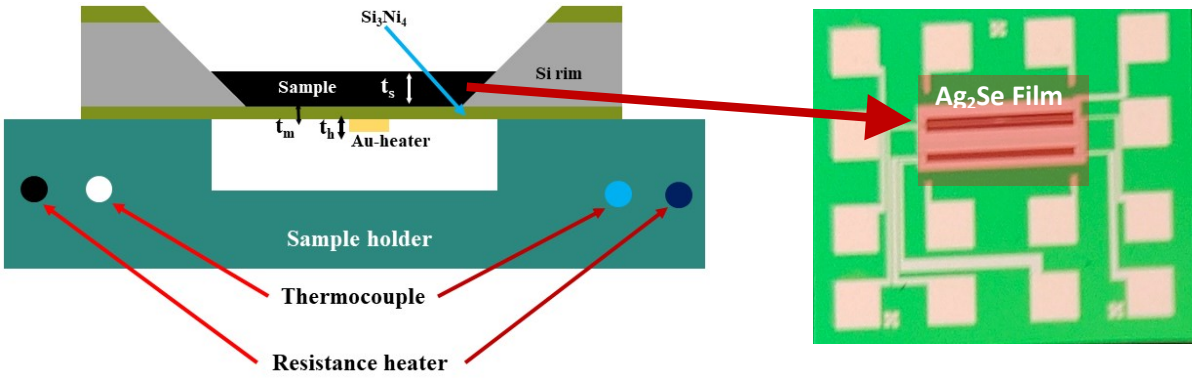

Fig. S4: Schematic diagram of the ZT-chips. The TFA chip is used to measure TE parameters of the Ag_2Se films.

The thermal conductivity of a film on a microchip is measured by Linseis TFA (thin film analyser) system, which is developed by V. Linseis et. al. [Ref.35]. based on the method presented by Völklein et. al.[Ref.36]. The TFA chip fabricated on a silicon wafer where two thin heater with a width < 5 µm are deposited on free standing Si3N4 membranes which is surrounded by and Au rim. The heaters are connected in a 4-wire configuration. A controllable

current (I) is applied to the heater, hence a heat flux is developed between the heater and surrounding silicon (heat sink). The thermal conductivity can be estimated by measuring temperature rise of the heater and applied heating power using heat flux model. The detail measurement procedure and mathematical models are described in Ref.35.

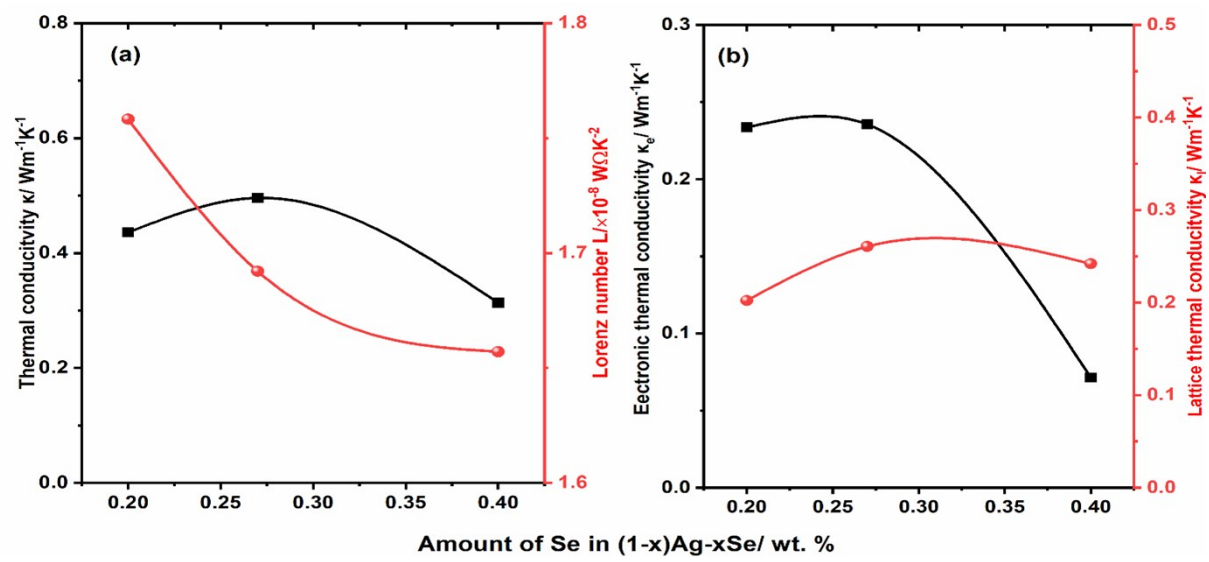

Fig. S5: Composition dependent κ & L (a) and κ_e & κ_l (b) of the film with x=0.20, 0.27 and 0.40.

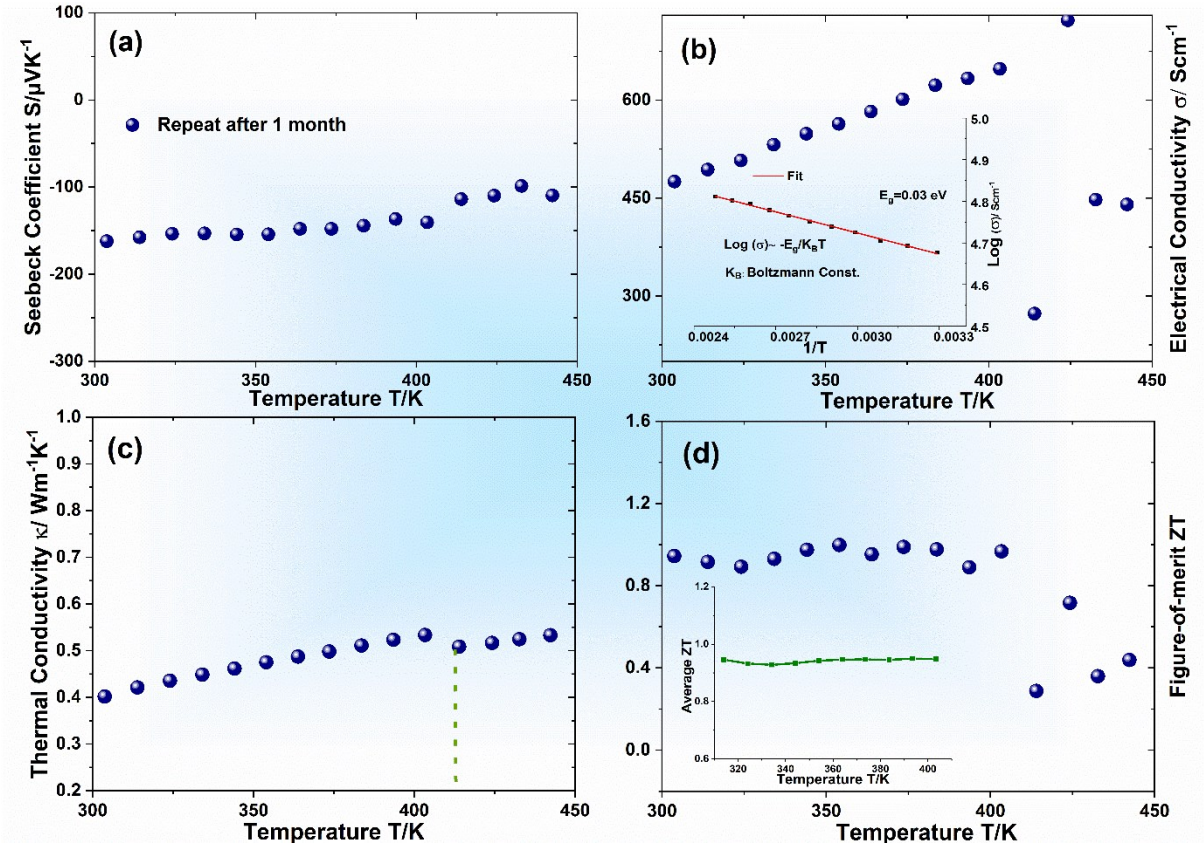

Fig. S6. The temperature dependent thermoelectric parameters (a) S, (b) σ and (c) κ of the film for x=0.27 a day and a month from 300 to 450 K. (d) The Fig.-of-merit ZT of the printed film is found to be repeatable even after a month. A high average ZT value of □0.94 is achieved in the film between 300 and 400 K (inset of d).

To check repeatability of the results, the temperature dependent TE parameters were measured after 1 month and its TE properties are studied in the temperature range from 300 to 450 K. The printed material is found to be exhibited similar TE performance. At lower temperatures, the electrical conductivity increases with increasing temperature up to 400 K, showing semiconducting behaviour. The electrical band gap can be estimated from the slop of log (σ) vs 1/T curve. A value of □ 0.03 eV is found, indicating a rather narrow bandgap semiconductor.