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Supporting Information

for *Adv. Mater. Interfaces*, DOI 10.1002/admi.202301086

Sequentially PVD-Grown Indium and Gallium Selenides Under Compositional and Layer Thickness Variation: Preparation, Structural and Optical Characterization

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Supplementary

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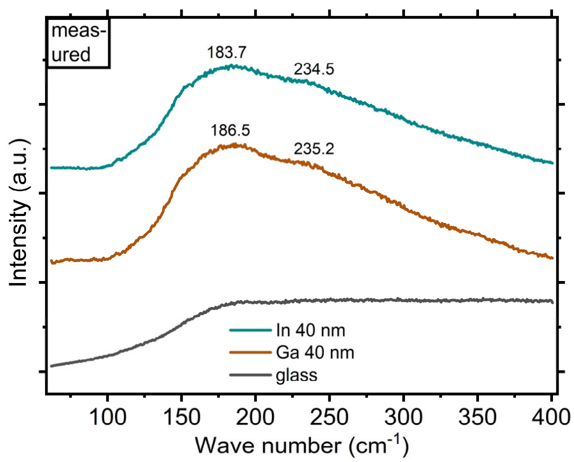

Figure S1: Measured Raman spectra of pure In, Ga, and glass.

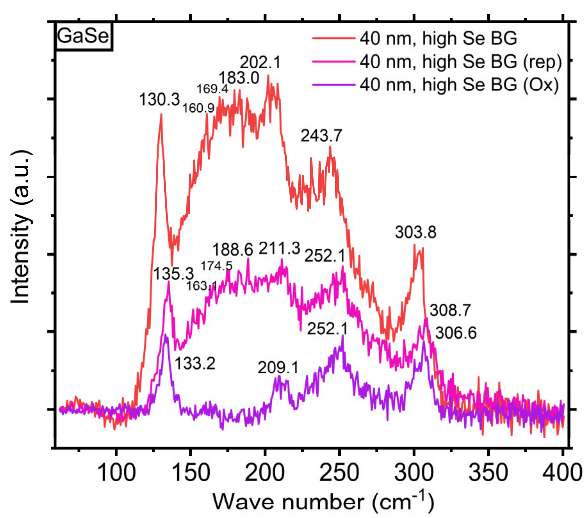

Figure S2: Measured Raman spectra of GaSe (prepared by chalcogenization in high Se background of a 40 nm Ga precursor film) immediately after preparation, after being exposed to air during the various measurements (rep) or for three days (Ox).

Table S1: Overview of XRD-database files from where the peak lines representing different compounds and phases of In-Se in Figure 3 were extracted.
COD: Crystallography Open Database (http://www.crystallography.net)
SD: Springer Materials (for In_4Se_3 https://materials.springer.com/isp/crystallographic/docs/sd_0451600)

	chemical formula	Data base no
150 nm, 0.2 g Se	γ-In_2Se_3	COD_2106380
150 nm, 0.1 g Se	γ-In_2Se_3	COD_2106380
150 nm, high Se BG	β-/γ-InSe ; In_4Se_3	COD_9008967/ COD_1534648 ; SD_0451600
150 nm, low Se BG	α-/β-In_2O_3 ; In	COD_9015718 ; COD_1512513
100 nm, 0.2 g Se	γ-In_2Se_3	COD_2106380
100 nm, 0.1 g Se	γ-In_2Se_3	COD_2106380
100 nm, high Se BG	β-/γ-InSe	COD_9008967/ COD_1534648
100 nm, low Se BG	β-/γ-InSe ; α-/β-In_2O_3	COD_9008967/ COD_1534648 ; COD_9015718
40 nm, high Se BG	γ-In_2Se_3 ; α-In_2Se_3	COD_2106380 ; COD_1528775
40 nm, low Se BG	γ-In_2Se_3 ; α-In_2Se_3	COD_2106380 ; COD_1528775
20 nm, high Se BG	γ-In_2Se_3 ; α-In_2Se_3	COD_2106380 ; COD_1528775
20 nm, low Se BG	α-In_2Se_3 ; γ-In_2Se_3	COD_1528775 ; COD_2106380

Table S2: Overview of XRD-database files from where the peak lines representing different compounds and phases of Ga-Se in Figure 4 were extracted.
COD: Crystallography Open Database (http://www.crystallography.net)
ICSD: FIZ-Karlsruhe, Leibniz Institute for Information Infrastructure (http://icsd.fiz-karlsruhe.de)

	chemical formula	Data base no
150 nm, 0.2 g Se	α-/β-Ga_2Se_3	COD_2020137 / ICSD_35028
150 nm, 0.1 g Se	α-/β-Ga_2Se_3	COD_2020137 / ICSD_35028
150 nm, high Se BG	β-/γ-/δ-/ε-GaSe	COD_1530863 / ICSD_73388 / COD_2106698 / COD_2105478
150 nm, low Se BG	β-Ga_2O_3 ; Ga	COD_2004987 ; COD_8104301
100 nm, 0.2 g Se	α-/β-Ga_2Se_3	COD_2020137 / ICSD_35028
100 nm, 0.1 g Se	α-/β-Ga_2Se_3	COD_2020137 / ICSD_35028
100 nm, high Se BG	β-/γ-/δ-/ε-GaSe	COD_1530863 / ICSD_73388 / COD_2106698 / COD_2105478
100 nm, low Se BG	β-Ga_2O_3 ; β-/γ-/δ-/ε-GaSe ; Ga	COD_2004987 ; COD_1530863 / ICSD_73388 / COD_2106698 / COD_2105478 ; COD_8104301
40 nm, high Se BG	β-/γ-/δ-/ε-GaSe	COD_1530863 / ICSD_73388 / COD_2106698 / COD_2105478
40 nm, low Se BG	β-Ga_2O_3 ; Ga	COD_2004987 ; COD_8104301
20 nm, high Se BG	α-/β-Ga_2Se_3	COD_2020137 / ICSD_35028
20 nm, low Se BG	Ga ; β-Ga_2O_3	COD_8104301 ; COD_2004987

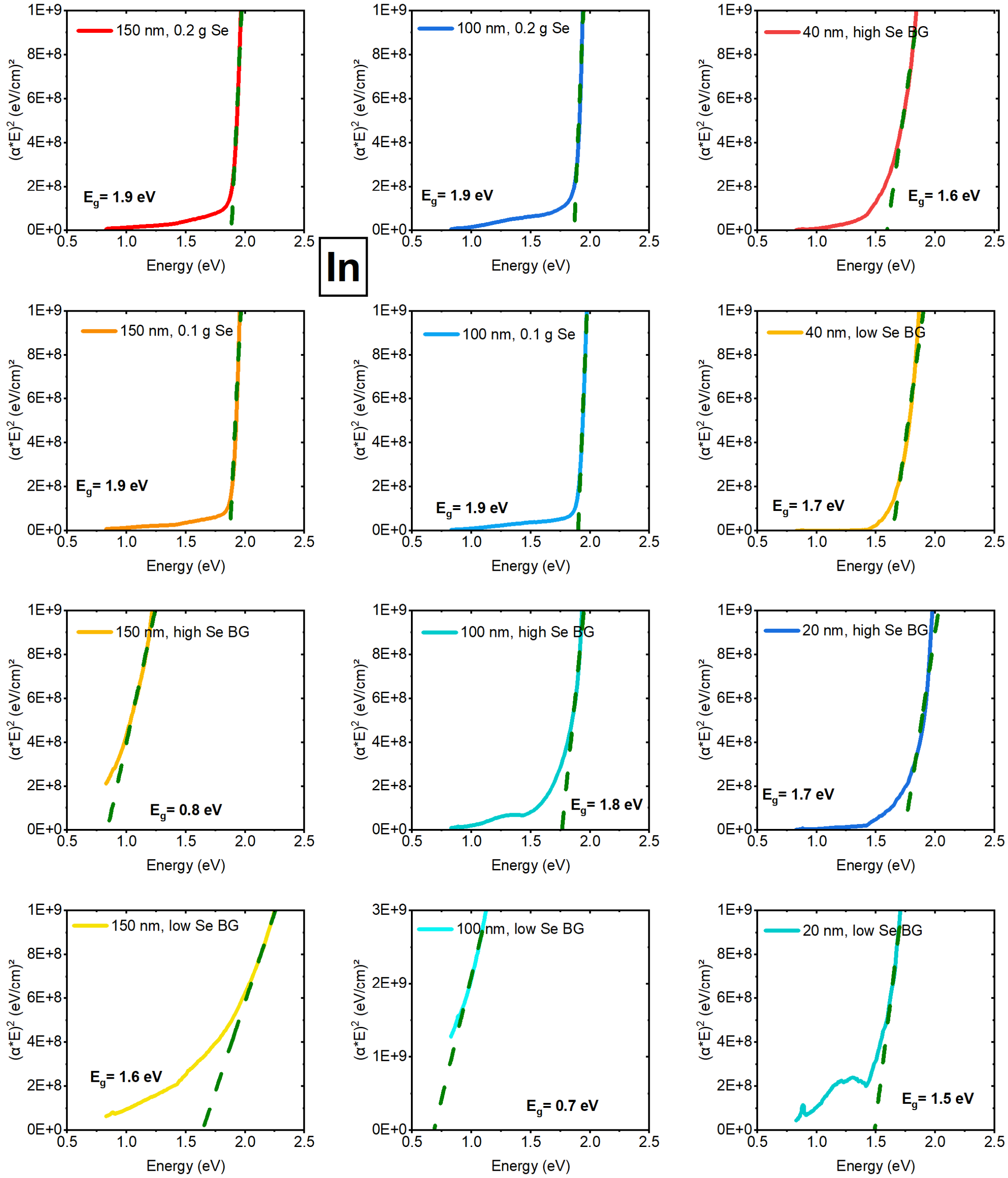

Figure S3: Tauc plot of $(\alpha E)^2$ for potential derivation of direct band gap value from linear fitting; In-Se samples with 150, 100, 40 or 20 nm In precursor thickness and selenized in various Se content (BG = background).

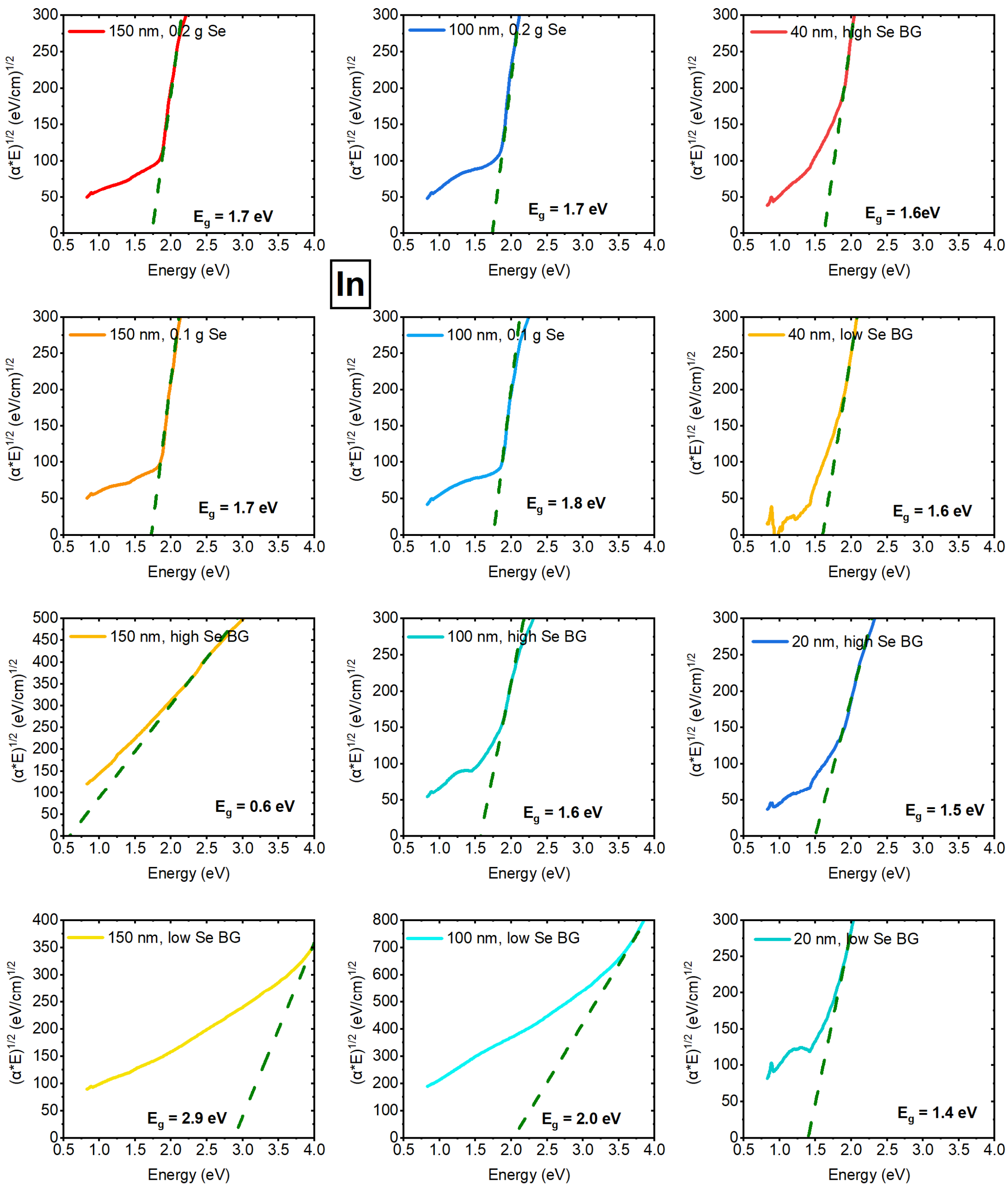

Figure S4: Tauc plot of $(\alpha E)^{1/2}$ for potential derivation of indirect band gap value from linear fitting; In-Se samples with 150, 100, 40 or 20 nm In precursor thickness and selenized in various Se content (BG = background).

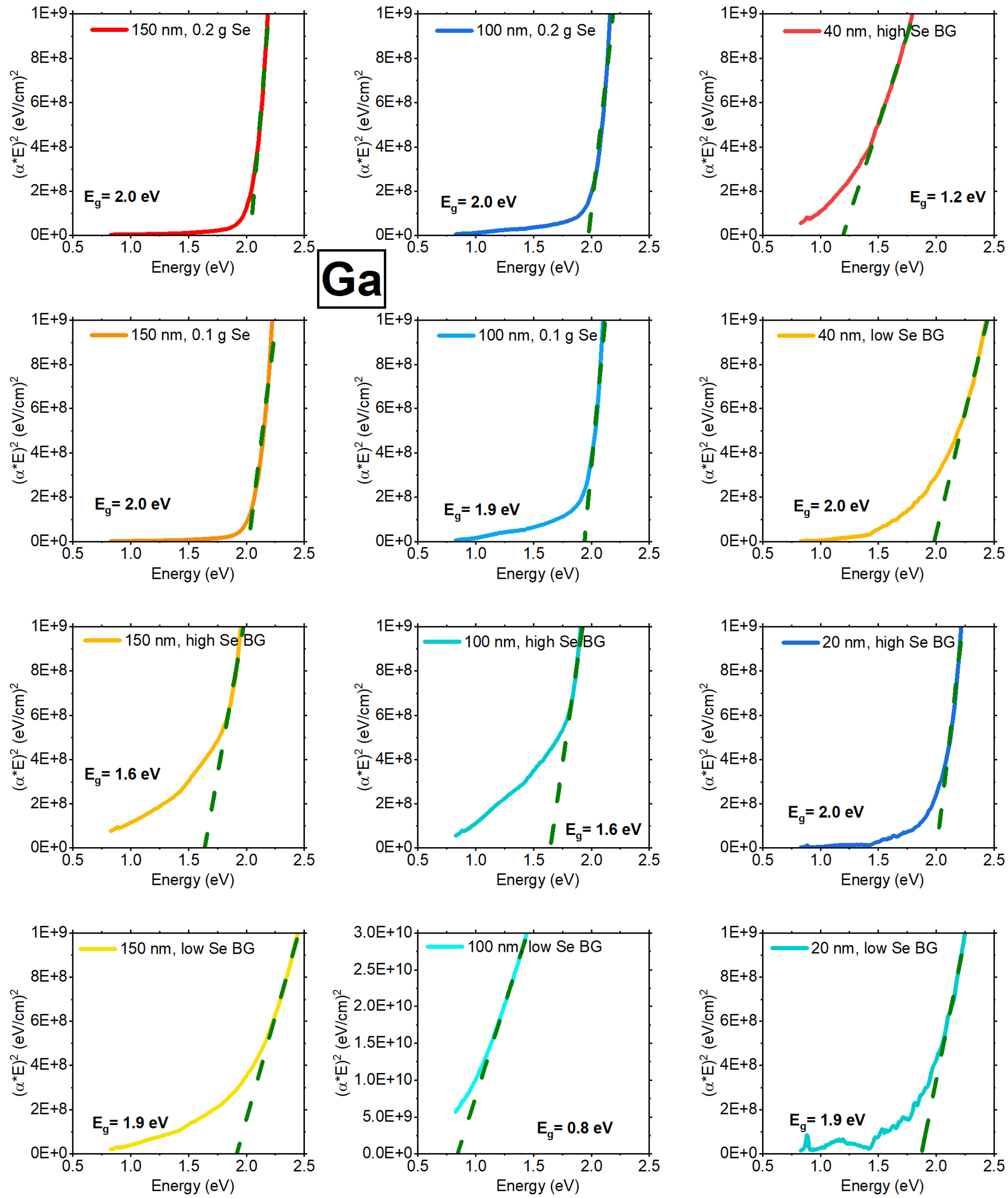

Figure S5: Tauc plot of $(\alpha E)^2$ for potential derivation of direct band gap value from linear fitting; Ga-Se samples with 150, 100, 40 or 20 nm Ga precursor thickness and selenized in various Se content (BG = background).

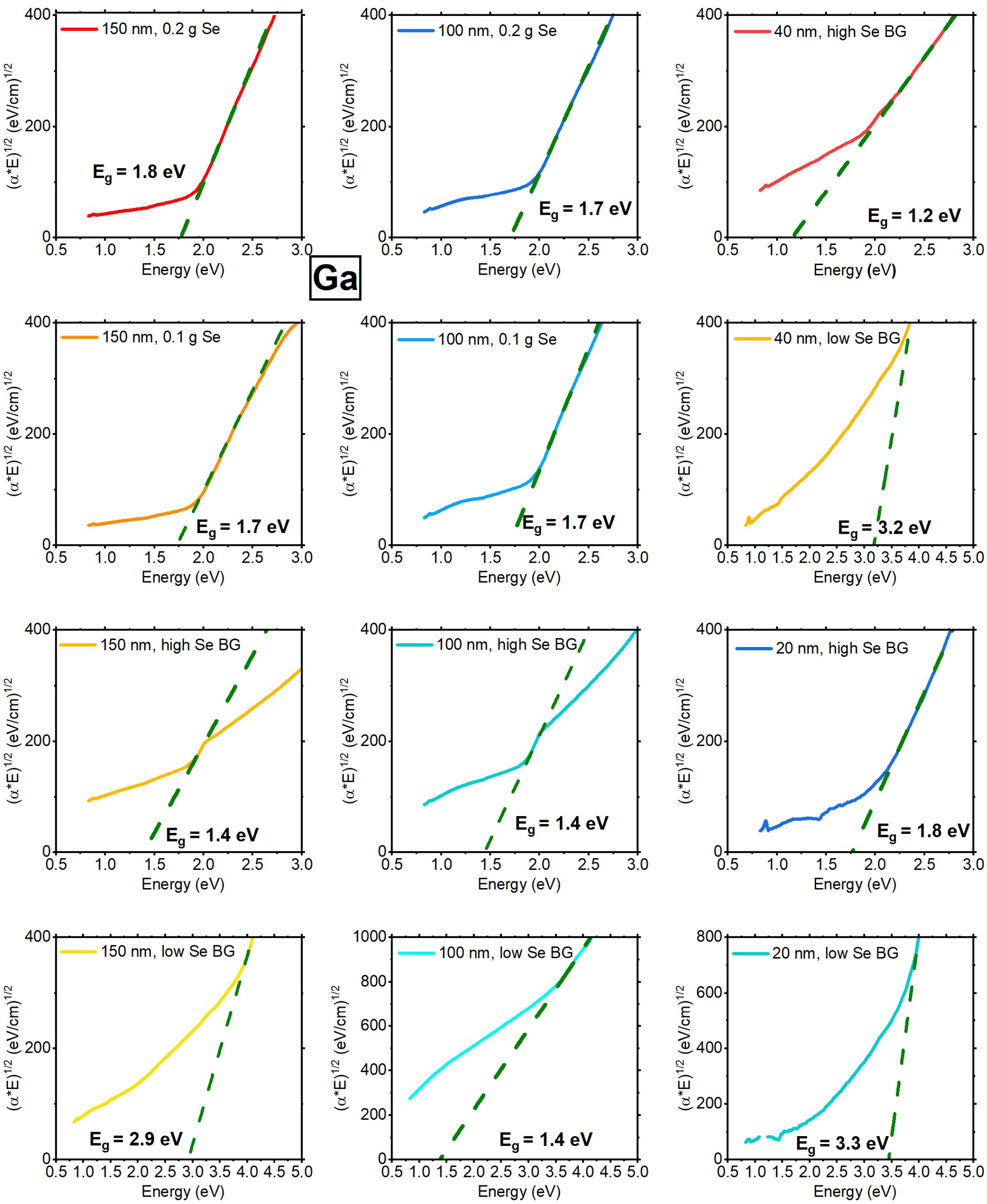

Figure S6: Tauc plot of $(\alpha E)^{1/2}$ for potential derivation of indirect band gap value from linear fitting; Ga-Se samples with 150, 100, 40 or 20 nm Ga precursor thickness and selenized in various Se content (BG = background).