

Supplementary Figures

Figure S1

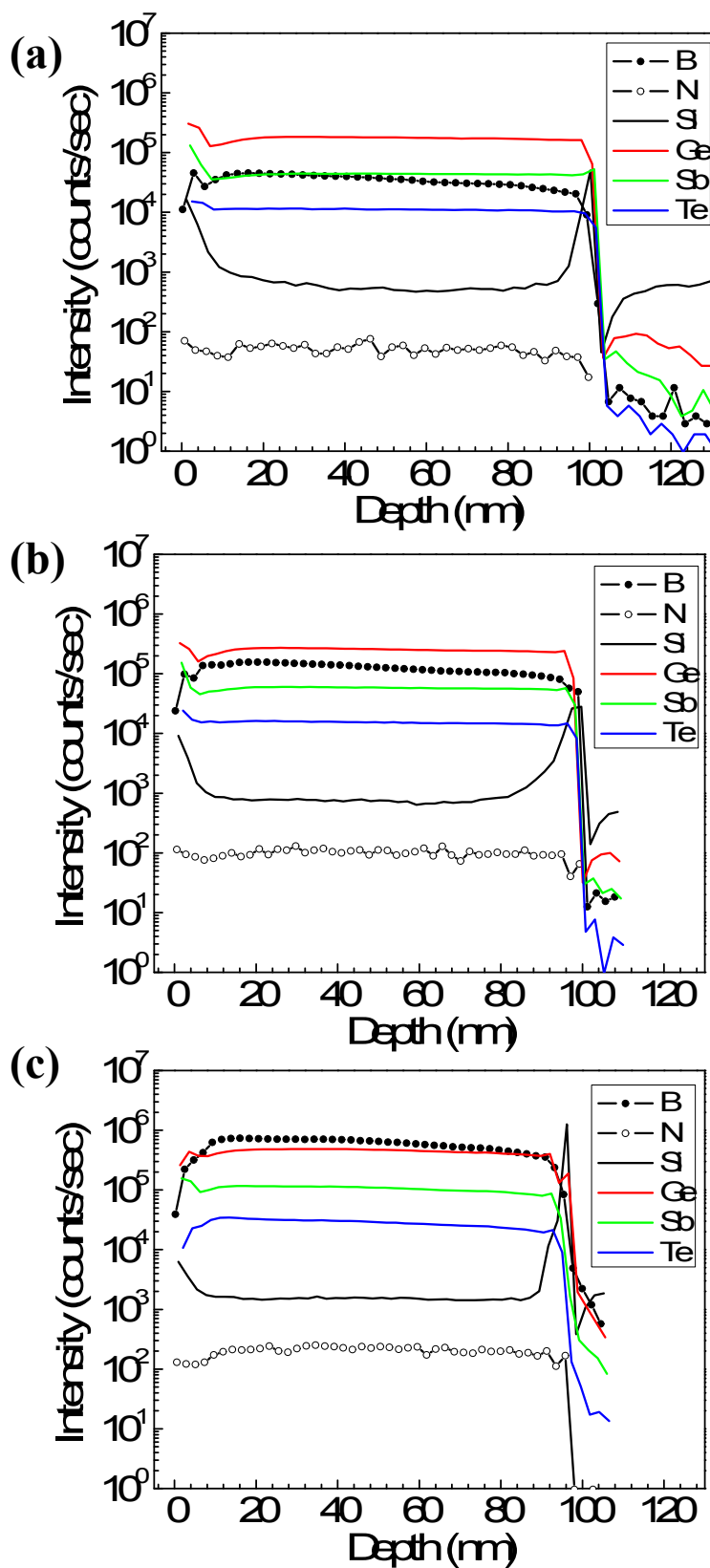
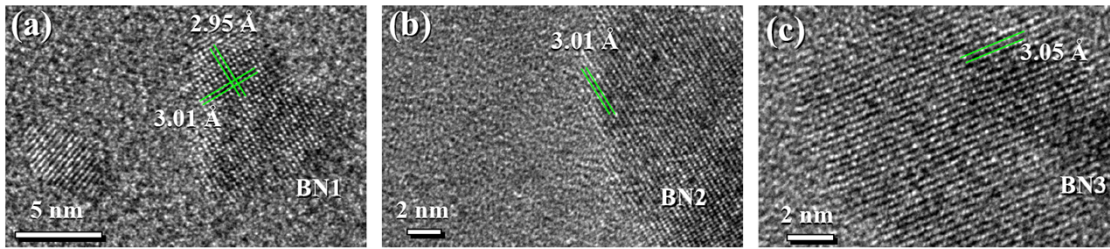


Figure S1. The dynamic secondary ion mass spectroscopy (SIMS) depth profiles for the (a) BN1, (b) BN2, and (c) BN3 films. Each film has a uniform distribution of B and N. In addition, the amount of B and N increase as the sample index increases.

Figure S2

220°C



320°C

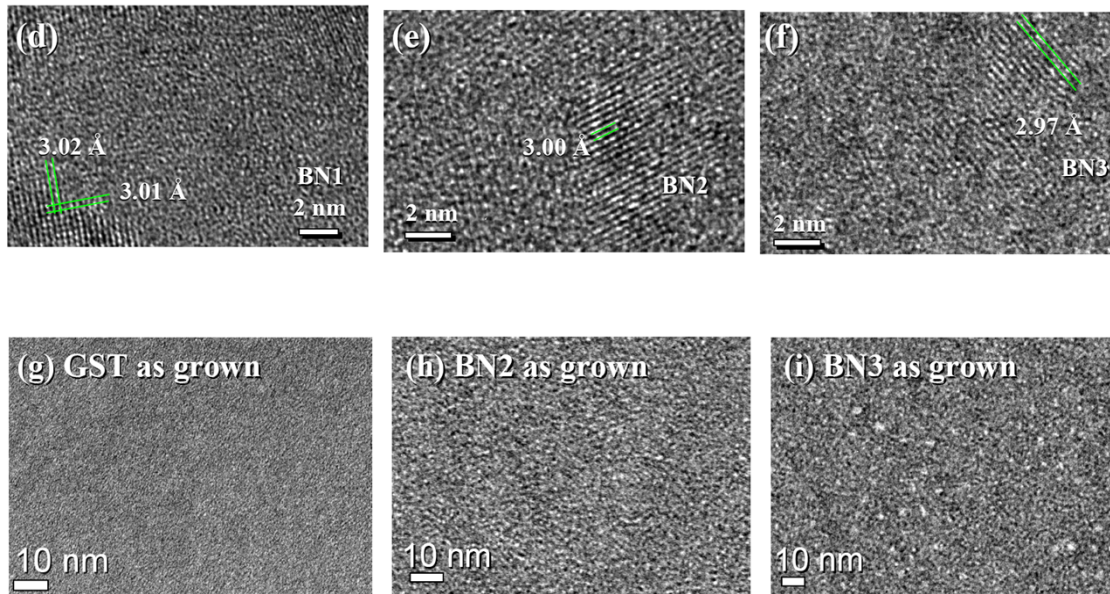


Figure S2. High-resolution transmission electron microscopy (HRTEM) images of the (a) BN1, (b) BN2, and (c) BN3 films with annealing at 220°C and (d) BN1, (e) BN2, and (f) BN3 films at 320°C for 10 min. The lattice spacing values and green lines in the images of the annealed films indicate the GST FCC (200) phase. HRTEM images for the as-grown (g) GST, (h) BN2, and (i) BN3 films.

Figure S3

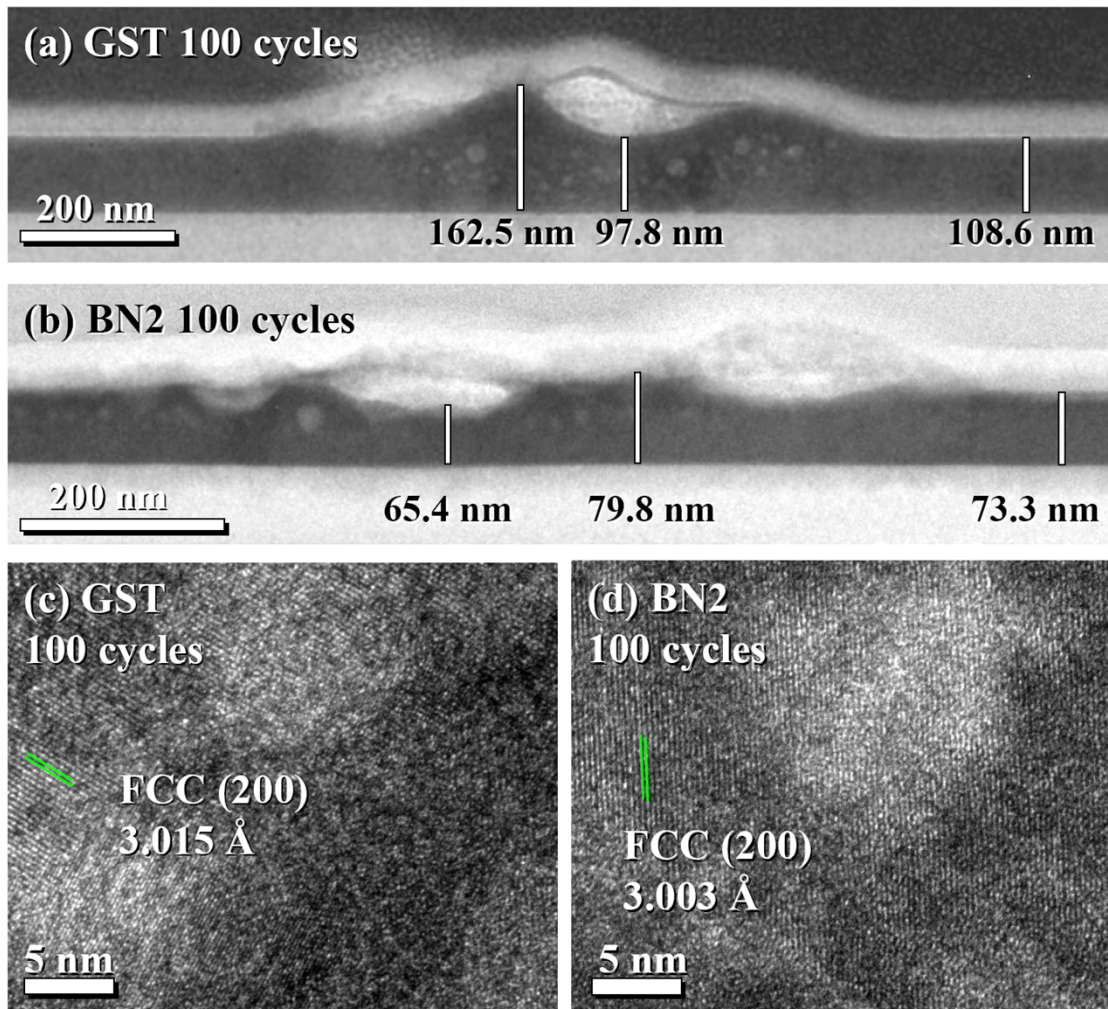


Figure S3. Cross-sectional TEM images of the laser-irradiated areas after 100 cycles of SET/RESET repetition in the (a) GST and (b) BN2 films. The thicknesses of the virgin films are indicated on the right side of each figure. In addition, the maximum and minimum thickness values are also indicated in the middle of each figure. High-resolution transmission electron microscopy (HRTEM) images of the (c) GST and (d) BN2 films after 100 SET/RESET cycles with nanosecond pulsed laser irradiation. The lattice spacing values and the green lines in all of the images indicate the FCC(200) phase.

Figure S4

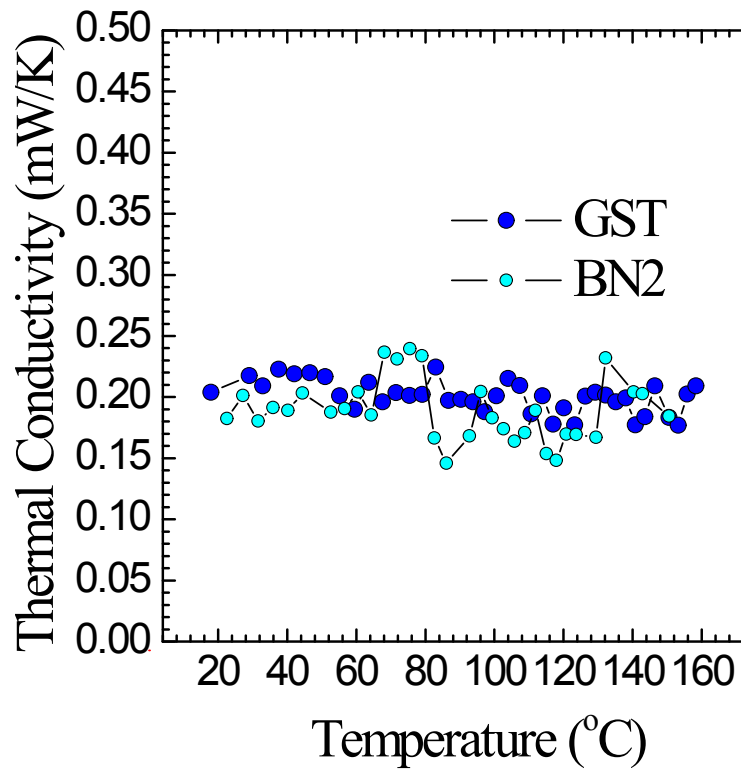


Figure S4. The *in-situ* thermal conductivity of GST and BN2 films in amorphous state as a function of temperature.

Figure S5

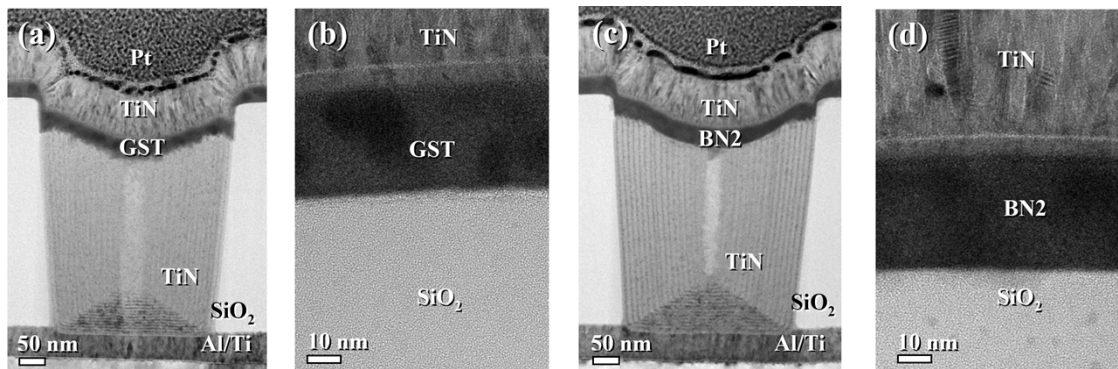


Figure S5. (a) Cross-sectional TEM image of the actual GST device obtained by FIB cutting. (b) A higher magnified TEM image of the GST active layer. (c) Cross-sectional TEM image of the actual BN2 device obtained by FIB cutting. (d) A higher magnified TEM image of the BN2 active layer.

Table SI. N concentration of the BN-incorporated GST films.

Sample index	BN1	BN2	BN3
N concentration (at. %)	2.28	5.95	7.87