

# Supplementary Data

## Table S1

Table S1. Raman peaks in Figure 2, marked as A–E, for the as-grown film are compared with those for the re-amorphized film. The value of each peak area is listed in this table. The basic information for structural ratio summarized in Table 1 can be derived using these values.

	Amorphous GST	Reamorphized GST	Amorphous CGST(5%)	Reamorphized CGST(5%)	Amorphous CGST(10%)	Reamorphized CGST(10%)
A	3167	3396	3327	3992	4095	4170
B	1343	903	1105	653	1539	968
C	4131	3909	4584	5478	6051	7740
D	11666	15159	12861	15640	12946	12049
E	569	1022	529	689	1321	1321

## Table S2

Table S2. Fitting parameters and average coordination numbers from the Ge K-edge X-ray absorption spectra of GST and the 5% and 10% CGST films. The EXAFS data were analyzed with the FEFF8 code using an optimized structure, and the structural parameters were optimized using ARTEMIS.

	GST	CGST(5%)	CGST(10%)
	Ge-Te	Ge-Te	Ge-Te
R	2.83 Å	2.77 Å	2.81 Å
N	2.40	3.34	3.17
$\chi^2/\nu$	$0.012 \pm 0.0039$	$0.016 \pm 0.0016$	$0.022 \pm 0.0059$

## Table S3

Table S3. Equation of the reset energy of GST and 5% and 10% CGST devices is derived as  $E_{\text{reset}} = (V_{\text{reset}}^2/R_{\text{set}}) \times t_{\text{reset}}$ . The reset energy of 5% CGST (~0.2 nJ) increases more than twice that of GST (~0.1 nJ). When the carbon content in CGST is doubled (i.e., 10%), the reset energy slightly increases to ~0.21 nJ compared with that in 5% CGST

Reset Energy [nJ]		
GST	CGST(5%)	CGST(10%)
0.098	0.204	0.216