Supplementary Figures

Fenton Reaction for Enhancing Polishing Rate and Protonated Amine Functional Group Polymer for Inhibiting Corrosion in $Ge_1Sb_4Te_5$ Film Surface Chemical–Mechanical-Planarization

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Figure S1

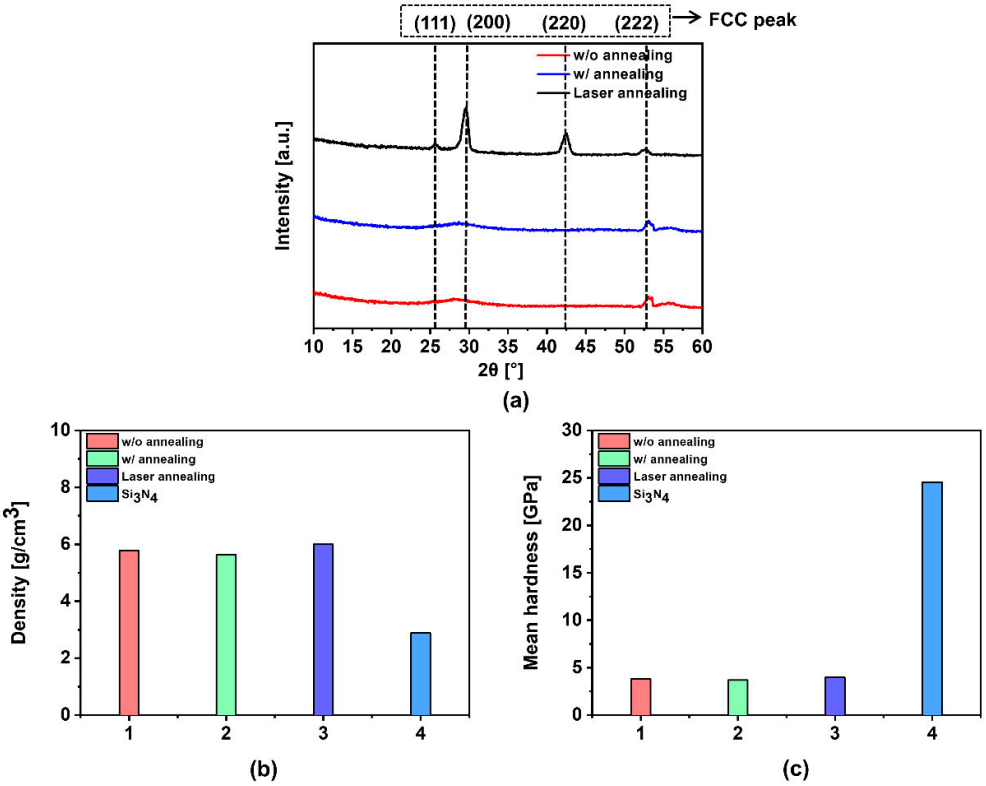


Figure S1. Material properties of $Ge_1Sb_4Te_5$ film subjected to sputtering followed by laser annealing. (a) Crystallinity of $Ge_1Sb_4Te_5$ film characterized by X-ray diffraction. Comparison between (b) density (b) and (c) hardness of as-sputtered $Ge_1Sb_4Te_5$ film, thermal-annealed $Ge_1Sb_4Te_5$ film, laser-annealed $Ge_1Sb_4Te_5$ film, and Si_3N_4 film.

Figure S2

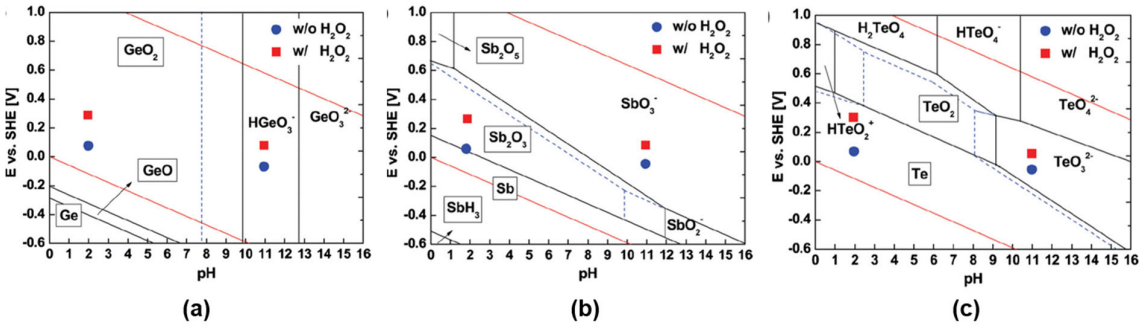


Figure S2. Pourbaix diagram for $Ge_1Sb_4Te_5$ film surface. (a) GeO_2, (b) Sb_2O_3, and (c) TeO_2.

Figure S3

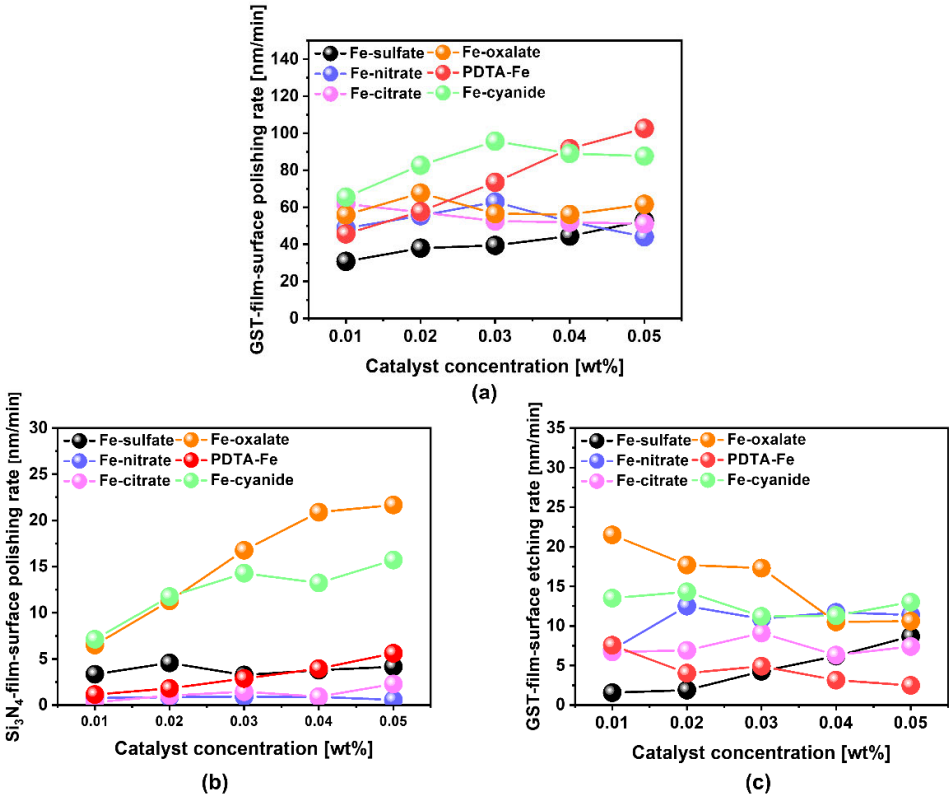


Figure S3. Dependency of CMP performance on ferric ionic catalyst types and catalyst concentration for Fenton reaction of $Ge_1Sb_4Te_5$ film surface CMP slurry. (a) Polishing rate of $Ge_1Sb_4Te_5$ film surface, (b) polishing rate of Si_3N_4 film surface, and (c) etching (corrosion) rate of $Ge_1Sb_4Te_5$ film surface according to ferric ionic catalyst types and catalyst concentration.

Figure S4

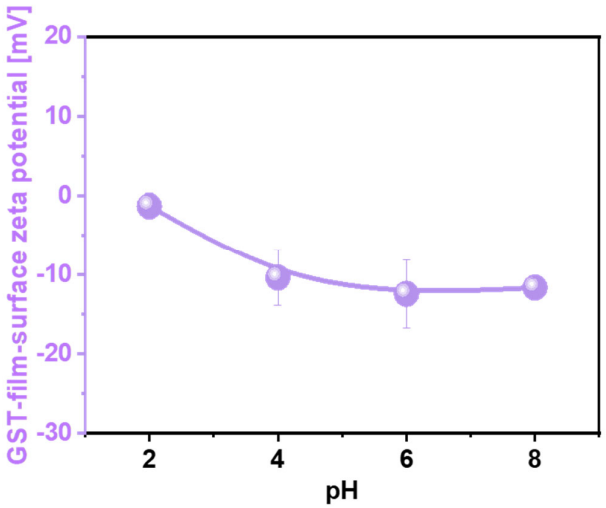


Figure S4. Zeta potential of $Ge_1Sb_4Te_5$ film surface against pH.

Figure S5

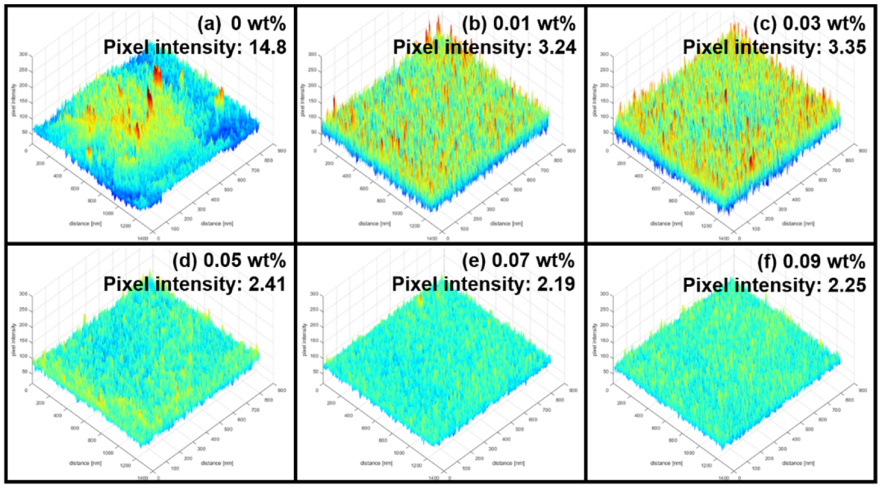


Figure S5. Dependency of relative surface roughness (i.e., pixel intensity) on the concentration of the corrosion inhibitor (i.e., PEI) determined using SEM images of the $Ge_1Sb_4Te_5$ film surface after CMP. PEI concentrations of (a) 0, (b) 0.01, (c) 0.03, (d) 0.05, (e) 0.07, and (f) 0.09 wt%.

Figure S5

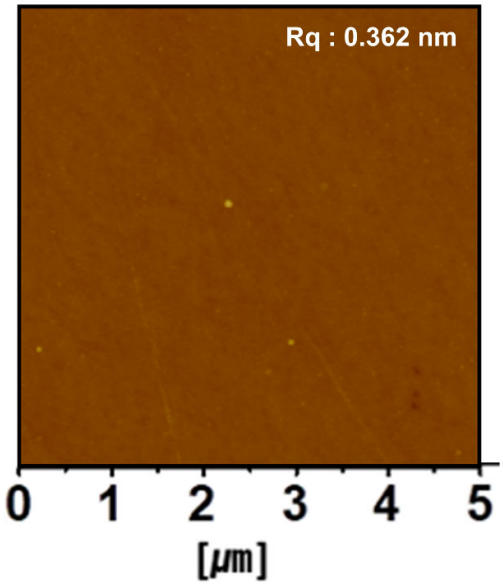


Figure S6. Surface roughness (Rq) of the polished $Ge_1Sb_4Te_5$ film surface using $Ge_1Sb_4Te_5$ film surface CMP slurry including the PDTA-Fe of 0.05wt% and PEI 0.09 wt%, measured by AFM in the scanning area 5x5 um

Table S1

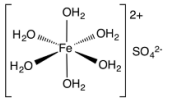
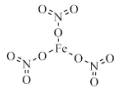
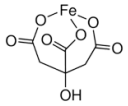
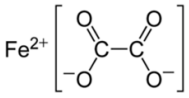
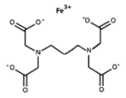
Fe-sulfate	**$FeSO_4$**	
Fe-nitrate	**$Fe(NO_3)_3$**	
Fe-citrate	**$C_6H_5FeO_7$**	
Fe-cyanide	**$[Fe(CN)_6]^{3-}$**	
Fe-oxalate	**$C_6Fe_2O_{12}$**	
PDTA-Fe	**$C_{11}H_{12}FeN_2O_8$**	

Table S1. Chemical structure of ferric-ionic-catalysts.