Phase change behaviors of Cr-Ge-Te compound thin film

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ABSTRACT

Phase Change Random Access Memory (PCRAM) is expected as a next generation non-volatile memory (NVM). However, the thermal stability of phase change material in amorphous state should be improved for high temperature application. In our previous study, we found that Cr doping can increase the crystallization temperature (T_x) of GeTe amorphous [1]. However, Cr doping into GeTe led the phase separation after crystallization which deteriorates reliability and repeatability. In Cr-Ge-Te ternary system, there is $Cr_2Ge_2Te_6$ (CGT) compound [2]. Therefore, in this study, we investigated phase change behaviors of CGT thin film.

Figure 1 shows the temperature dependence of the resistance for CGT and GeTe-6.1 at.%Cr films measured by two-point probe method. As-deposited and annealed CGT films were confirmed to be amorphous and crystalline phases by X-ray diffraction (XRD), as shown in Figure 2. The resistance of the amorphous CGT is a much lower than that of the amorphous GeTe-6.1 at.%Cr and decreased with increasing temperature until 290 ℃. With further increasing temperature, resistance began to increase from 290 ℃, and in cooling process, resistance increased. Consequently, the resistance of the crystalline CGT film is higher than that of the amorphous CGT film. In addition, the T_x of the amorphous CGT film was determined with differential scanning calorimetry (DSC) and was estimated to be about 270 ℃. This means that a relatively large resistance decrease at around 270 ℃ is due to crystallization and the resistance increases with increasing temperature after crystallization. CGT was found to show completely different resistance change behaviors from conventional PCMs. In this presentation, the activation energy for crystallization and crystallization kinetics of CGT will be also discussed.

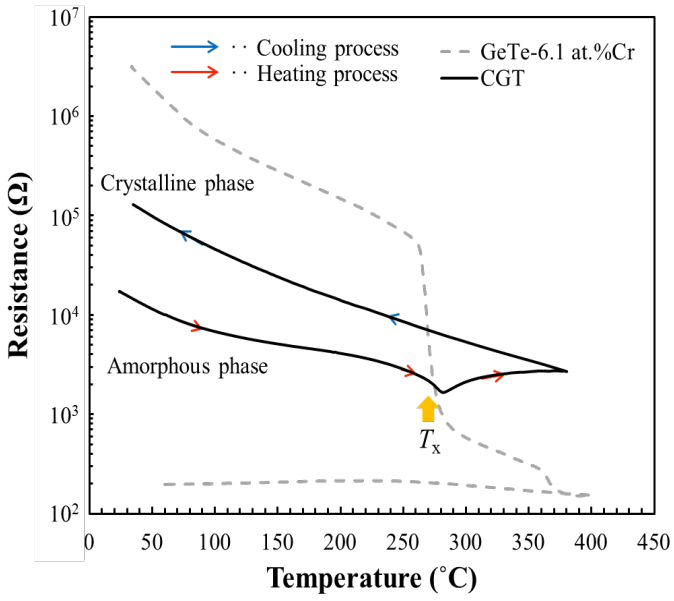

Fig.1 Temperature dependence of resistance for CGT film

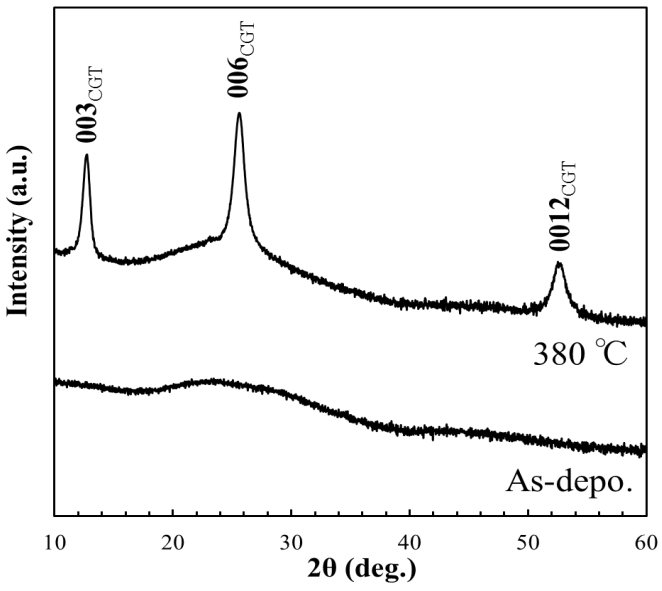

Fig.2 XDR patterns for CGT films

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