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Effects of growth temperature and post-annealing on $Pr_{0.7}Ca_{0.3}MnO_3$ film with $SrRuO_3$ buffer layer for ReRAM applications

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There has been a lot of recent interest in the properties of manganites such as $RE_{1-x}A_xMnO_3$ (RE is a rare earth such as La, Pr, Nd, and A is an alkaline earth such as Ca, Ba, or Sr) in particular due to a spectacular decrease of electrical resistance under a magnetic field, the so-called colossal magnetoresistance (CMR). Particularly, $Pr_{0.7}Ca_{0.3}MnO_3$ (PCMO) film is candidate material for the active material in ReRAM device.

Resistance switching behaviors of the $Pr_{0.7}Ca_{0.3}MnO_3$ (PCMO) film with $SrRuO_3$ (SRO) buffer layers, which were in situ deposited on Pt/Ti/SiO_2/Si substrates by rf magnetron sputtering method, were investigated. The ratio of the resistance change of the PCMO film with SRO buffer layers in the high-resistance state to that in the low-resistance state turned out to be much lager than that of the PCMO film without SRO buffer layers.

The PCMO film was deposited at various substrate temperatures ranging 300℃ to 700℃. The ER (ElectroResistance) ratio (R_{high}-R_{low}/R_{low}) increased with increasing substrate temperature. When post-annealing in O_2 atmosphere for 2 hours at 400℃ to 600℃ after depositing SRO/PCMO/SRO, ER ratio showed improvement. It is thought that the O_2 post-annealing seems to the degradation of oxygen contents and defects in the PCMO film and SRO films. The Mn^{4+}/Mn^{3+} ratio at the PCMO film surface was changed by oxygen post-annealing, resulting in an increase of the ER ratio.