Electronic Supplementary Information

Non-aqueous Electrodeposition of Functional Semiconducting Metal Chalcogenides: $Ge_2Sb_2Te_5$ Phase Change Memory

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Estimation of the deposited film thickness using the charge

Charge calculations to provide a rough estimation of the electrochemical film thickness (d) were performed using the following equations. Although these are rudimentary approximations, they provide a useful guide.

$d = V_{GST}/A$

where V_{GST} is the calculated volume for GST and A is the electrode area.

$V_{GST} = (m_{GST} * mol_{GST\ atoms})/\rho_{GST}$

Where m_{GST}, $mol_{GST\ atoms}$ and ρ_{GST} are the average mass, number of mols and density of the GST

$\rho_{GST} = (\rho_{Ge} * \%_{Ge} + \rho_{Sb} * \%_{Sb} + \rho_{Te} * \%_{Te})/(100)$ (Average density for GST compound)

$m_{GST} = (m_{Ge} * \%_{Ge} + m_{Sb} * \%_{Sb} + m_{Te} * \%_{Te})/(100)$ (Average mass for GST compound)

$mol_{GST\ atoms} = |Q|/(q * n_{GST} * N_A)$

$n_{GST} = (n_{Ge} * \%_{Ge} + n_{Sb} * \%_{Sb} + n_{Te} * \%_{Te})/(100)$ (Average number of transferred e^- for GST compound)

n_{GST} is the number of electrons transferred for each element and is 4 for Ge and Te and 3 for Sb.

For a charge of –0.5 C, the obtained film thicknesses are 1407, 2501, 2106 nm for Ge, Sb, Te, respectively, when executing the calculations for the pure elements. Assuming a ratio of GST-225, the expected film thickness is 2028 nm.