In situ and real time spectroscopic ellipsometry of polycrystalline $CuInSe_2$ co-evaporation for narrow bandgap photovoltaic absorber layers

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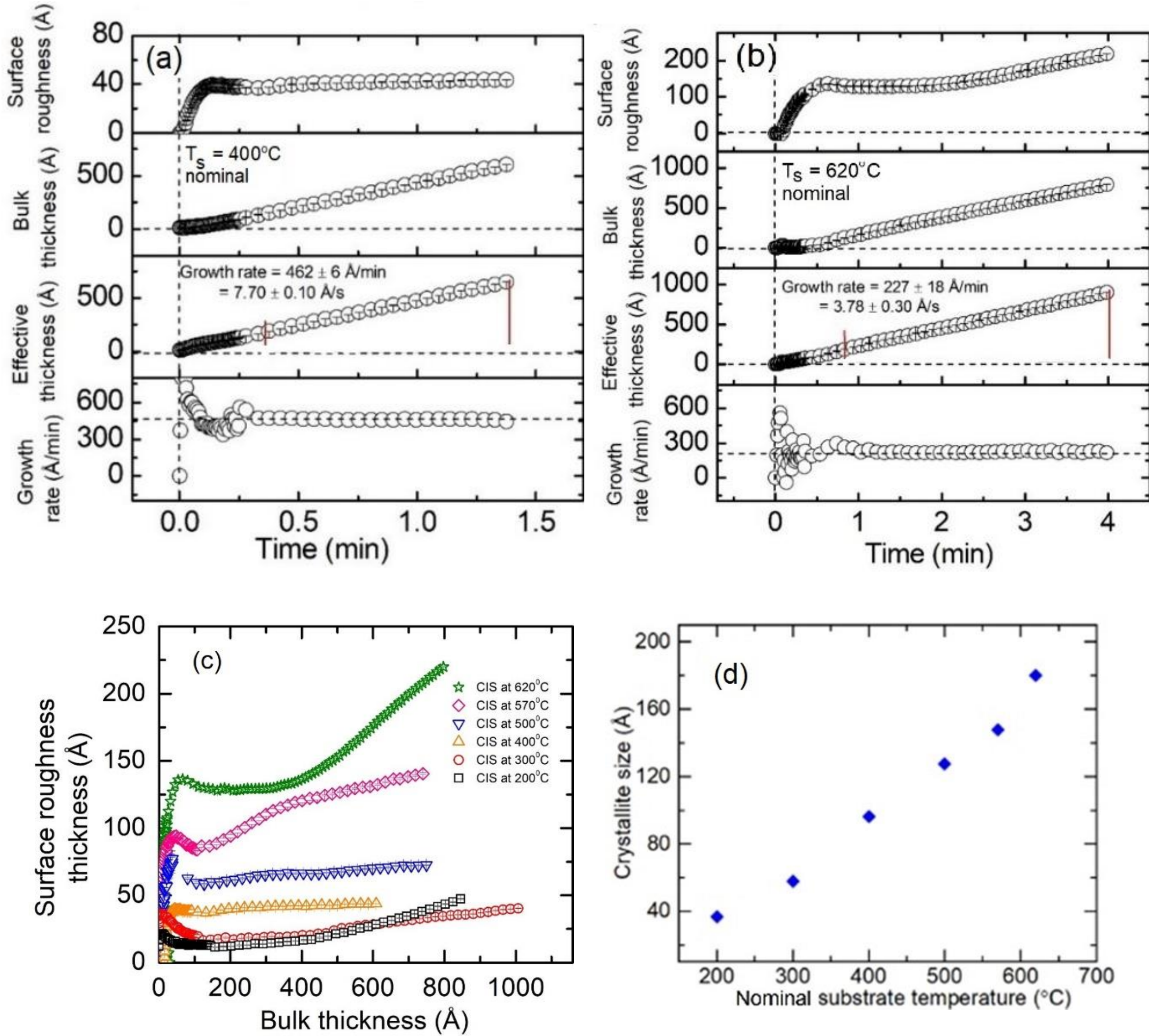

Figure 1: Structural evolution determined by real time spectroscopic ellipsometry for $CuInSe_2$ (CIS) thin films deposited at nominal substrate temperatures and rates of (a) 400°C and 7.7 Å/s, and (b) 620°C and 3.8 Å/s. A summary of such data is given in (c), presented as the surface roughness layer thickness as a function of the bulk layer thickness for the different temperatures. Also shown in (d) is the nominal substrate temperature dependence of the grain size that suggests a correlation between an enhancement in roughness evolution and the ultimate grain size in the CIS thin films.