Nanocalorimetric Study of the Amorphous-To-Liquid Transition in Ultrathin Films of A-Ge

A.F. Lopeandía[S], E. León-Gutierrez, G. Garcia, F. Pi, M.T.C. Mora and J. Rodríguez-Viejo[C]
Physics Department, Universidad Autónoma de Barcelona, Bellaterra, Spain
javirod@vega.uab.es

Germanium shows a large change in bonding from the 4-fold coordinated covalent amorphous phase to the 11-12 coordinated metallic liquid phase. This amorphous to liquid transition is first order and will only occur if crystallization is avoided by very rapid heating or by using ultrathin films below the critical size for nucleation. In this work we present direct calorimetric measurements of the amorphous-to-liquid transition occurring in ultrathin films (2-3 nm) of a-Ge sandwiched between 10 nm SiO_2 layers. SiO_2 is chosen to inhibit heterogeneous nucleation at the interfaces. The films are grown by High-Vacuum electron beam deposition onto the backside of a 180 nm thick freestanding SiN_x membrane that forms the nanocalorimetric cell. Patterned thin film heaters and sensors of Pt/Al_2O_3 are used to measure the voltage drop in four point configuration during fast heating rate scans ($5x10^4$ K/s). A twin system formed by two nearly identical calorimetric cells with a heat capacity at room temperature around 100 nJ/K allow for highly reproducible and sensitive measurements up to 1300 K. Because of the identical emissivity values in both cells, radiative corrections are performed to quantitatively determine the melting enthalpy of the transition. This is to our knowledge the first direct experimental measurement of the latent heat of the amorphous-liquid transition in germanium.