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Phase Transition Behavior of Organic Thin Film Observed High Sensitive DSC

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With decreasing the size of material, the structure and the molecular mobility of materials are influenced by the material-gas interface (surface) and the material-substrate interface (interface) due to the decrease of surface/volume ratio. The glass transition of polymer-gas surface is lower than that of bulk polymer, and the molecular mobility of polymer-solid substrate interface is expected to be lower than that in bulk polymer due to the attractive interaction between polymer and subtract surface. In this study, the phase transitions of organic thin film with thickness less than ・ were investigated as a function of sample mass (thickness). Poly(ethyleneoxide)s, PEO, with various degree of polymerization (PEO114, PEO272, PEO454) were used. PEO thin films were prepared by solvent casting form 5 to 10 micro-liter of Toluene solution of PEO with 1.0 to 0.1 wt% in 5 mm diameter aluminum sample vessel. DSC measurements were performed at 5 K/ min using SII NanoTechnology X-DSC7000. Sample mass used was from 1 microgram to 1 mg. We measured 1st and 2nd heating DSC curves of as-casted PEO454 with various sample mass, respectively. As-casted sample showed double endothermic peaks due to melting around 60 ℃ lower than that of bulk sample at 65.5 ℃. 2nd heating DSC curves were prepared by cooling from the molten state at 5 K/min. All sample showed the single melting peak, and the melting temperature decreased with decreasing the sample mass. Although the accuracy of sample mass less than 10 microgram, the DSC heating curves normalized by sample mass were almost the same, which indicated that the melting enthalpy was scarcely influenced by sample mass. The melting temperature difference between ultra-thin films prepared by solvent casting and cooling from the molten state was due to the morphology difference.