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Effect of Cooling Rate on Microstructure and Charge Transport in Semiconducting Polymer Thin Films[1] EVAN KANG, EUNSEONG KIM, KAIST, CENTER FOR SUPERSOLID AND QUANTUM MATTER RESEARCH TEAM — Thermal annealing of polymer thin films often enhances charge carrier mobility which can be attributed to self-healing of the film morphology. We have investigated the effect of cooling rate following the annealing treatment on the thin film microstructure and the charge transport properties using a high performance semiconducting polymer, poly(2,5-bis(3-alkylthiophen-2-yl)thieno[3,2-b]thiophene) (PBTTT). The cooling rate plays a key role in determining the microstructure and performance of polymer thin films. Differential scanning calorimeter measurement shows that fast cooling suppresses the crystallization process. The microstructure of thin films is investigated by using 2D X-ray diffraction and atomic force microscopy. Slow cooling results in well-connected large domains with enhanced three dimensional ordering whereas fast cooling leads to misalignment of small domains with relatively rough surface. Transport characteristics at various temperatures show increase in the charge carrier mobility and decrease in the activation energy when the cooling rate is slowed. This change in the mobility and activation energy becomes saturated with cooling rate below 15 $^{\circ}$C/min.

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Eunseong Kim
KAIST

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