博 士 論 文 の 内 容 の 要 旨

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学位授与年月日	2020 年 3 月 20 日
論文題目	Melt-printing technology based on fluid phase for organic thin-film transistors （流動相を利用した溶融印刷技術による有機トランジスタの開発）

（博士論文の内容の要旨）

Thanks to their potential for low temperature fabrication on low-cost large area flexible substrates, circuits based on organic thin film transistors (OTFTs) attract attention for the realization of next-generation electronics such as flexible displays, sensors, and radio-frequency identification tags. The organic thin films as the active layer in OTFTs are prepared by a thermal evaporation process and a solution process, and the latter is arguably regarded to be suitable for the low-cost large area circuits. The realization of this technology has been, however, questioned due to organic solvents exploited in its system to dissolve organic semiconductors (OSCs). There are several severe issues; (1) the usage of environmentally dangerous organic solvents such as a chlorine-based solvent, (2) the impurity indigenously existing in the solvents that hinders the uniform device outputs, (3) the evaporation of the solvents that complicates the control of the thin-film morphology. Hereby, we wonder if we can melt the OSC and spread the molten OSC between a polymer film with a solvent repellent finish and a substrate, leaving high crystalline organic thin-films on the substrate. In this thesis, a new melt-printing technology to exclude the troublesome solvents is developed. First, suspensions of organic semiconductors (naphthalene tetracarboxylic diimides with long alkyl chains at the *N*,*N*' positions as referred to NTCDI-C*n*) with different melting points are exploited for the development of this technology. A quality of the OSC thin-films related to set-up parameters, for example, process temperature, states of matter for the materials, and thickness of the films, is investigated. Then, the OTFTs are fabricated to check their electrical property, resulting in the highest electron mobility of 0.4 cm^2/Vs from the NTCDI-C13 TFTs. Second, we aim to developing a solvent-free process by replacing the OSC suspensions with an OSC powder to remove 2-propanol used as a poor solvent in the suspension. The comparison of the morphological and electrical measurements reveals that the quality of the resulting film prepared by using the powder melt-printing process resembles the one prepared by using the suspension melt-printing process. The highest electron mobility of 0.32 cm^2/Vs is obtained from the NTCDI-C13 TFTs. Also, the investigation of a printing film contributes to further understanding the mechanism of the process, resulting in an interesting finding that silica beads indigenously existed in the original polymer film works as spacers to keep a specific distance between the printing film and the substrate to create molecularly smooth thin-films with high crystallinity. The finding leads us to a conclusion that the control of crystal alignment in the films and the patterning of

the films are feasible. Finally, a home-made polymer film with no silica beads but with photoresist patterns as the controlled bumps is applied to the powder melt-printing process. As the result, the possibility to control the growth direction of crystalline and to pattern the films with one-shot is shown with the various shape of the thin-films even with the words.