Ultraflexible and stretchable organic devices

Takao Someya [1,2] **and Tsuyoshi Sekitani** [1,2]

[1] *School of Engineering, The University of Tokyo, 3-7-1 Hongo, Bunkyo-ku, Tokyo, Japan*
[2] *The Exploratory Research for Advanced Technology (ERATO), JST, Tokyo, Japan*

We have succeeded in manufacturing ultraflexible organic thin-film transistors, organic light-emitting diodes, and organic photovoltaic cells on ultrathin plastic film with the thickness as small as approximately 1 μm. These novel organic devices are much lighter than bird's feathers. First, we have demonstrated polymer-based photovoltaic devices on plastic foil substrates of 1.2 μm thick, with equal power conversion efficiency to their glass-based counterparts [1]. They can reversibly withstand extreme mechanical deformation and have unprecedented solar cell specific weight. Instead of a single bend, we were able to form a random network of folds within the device area. Then, we have manufactured organic transistors on ultrathin plastic films in order to achieve sharp bending radius less than 50 μm [2,3]. Bending cycle experiments will be presented to show the mechanical durability. Moreover, the issues and the future prospect of flexible organic devices such as thin-film transistors, photovoltaic cells, and memories will be addressed. In particular, the recent progress on reliability tests of organic devices, including thermal stability at 250 ºC, multiple bending cycles, stability in air, boiling water, and saline, will be presented [4]. Furthermore, ultraflexible and stretchable electronic systems have been exploited for biomedical applications such as medical catheters and implantable devices.

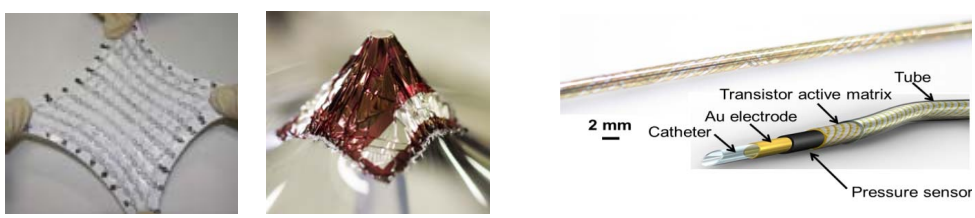

Figure 1: (Left) Stretchable integrated circuits based organic field-effect transistors. (Centre) Ultraflexible organic photovoltaic cell manufactured on a 1 μm-thick plastic film. (Right) Medical catheter with helical organic transistors integrated circuits.

[1] M. Kaltenbrunner, M. S. White, E. D. Glowacki, T. Sekitani, T. Someya, N. S. Sariciftci, S. Bauer, Nature Communications 3, 770 (2012).
[2] T. Sekitani, U. Zschieschang, H. Klauk, T. Someya, Nature Material 9, 1015 (2010).
[3] M. Kaltenbrunner, T. Sekitani, J. Reeder, T. Yokota, K. Kuribara, T. Tokuhara, M. Drack, R. Schwödiauer, I. Graz, S. Bauer-Gogonea, S. Bauer, and T. Someya (in press).
[4] K. Kuribara, H. Wang, N. Uchiyama, K. Fukuda, T. Yokota, U. Zschieschang, C. Jaye, D. Fischer, H. Klauk, T. Yamamoto, K. Takimiya, M. Ikeda, H. Kuwabara, T. Sekitani, Y-L. Loo, T. Someya, Nature Communications 3, 723 (2012).