Real-Time Observation of Nano-Scale Cutting Process

Acceleration of technical development for practical use such as fabrication and repair of nano-molds

Nano-mechanical fabrication technology using atomic force microscopes (AFM) has been developed for practical applications, however, the fabrication process has not been understood clearly yet, and thus optimal conditions for fabrication have been determined by trial and error. We have developed a nano-mechanical fabrication system using AFM which works in a scanning electron microscope (SEM), and thereby succeeded in the real-time observation of the nano-scale cutting process. This technique is expected to be a powerful tool for clarifying the removal mechanism of materials in cutting process, and for optimizing fabrication conditions, and to accelerate technological development for practical applications such as the fabrication and repair of nano-molds.

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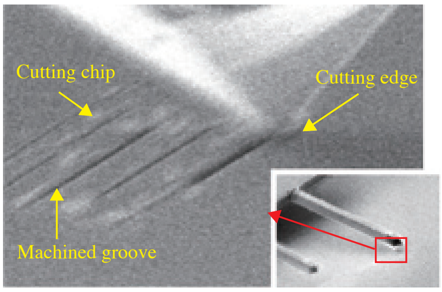

Figure 1: The SEM image of nano-cutting process (captured from movie)

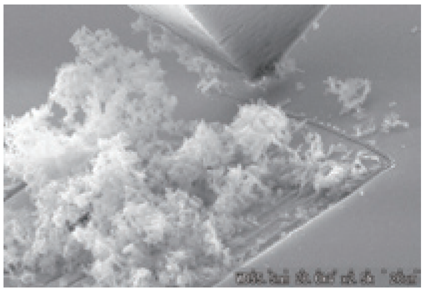

Figure 2: Cutting edge and chips after nano-cutting

Field-Effect Transistor (FET) of High-speed Operation Using a Liquid Crystal Semiconductor (LCS)

Development of a self-assembling organic semiconductor and a device fabrication

A novel liquid crystal semiconductor (LCS) has been developed under the collaboration with Kanto Chemicals Co. Ltd. The LCS was applied to "top-contact/bottom-gate" type field-effect transistor (FET) to investigate operation and on/off ratio of the FET with Osaka University. The LCS, a long-chain substituted dithienylnaphthalene, shows the fast hole mobility of 0.1 $cm^2\ V^{-1}s^{-1}$ in the plastic mesophase. Our FET shows the hole mobility of 0.14 $cm^2V^{-1}s^{-1}$ at room temperature, which is in the top class mobility of FETs made of LCS. The LCS characterized both by good solubility into various organic solvents and by "defect-free" property for electronic charge transport. The LCS is expected to become a novel organic semiconductor for high-performance devices.

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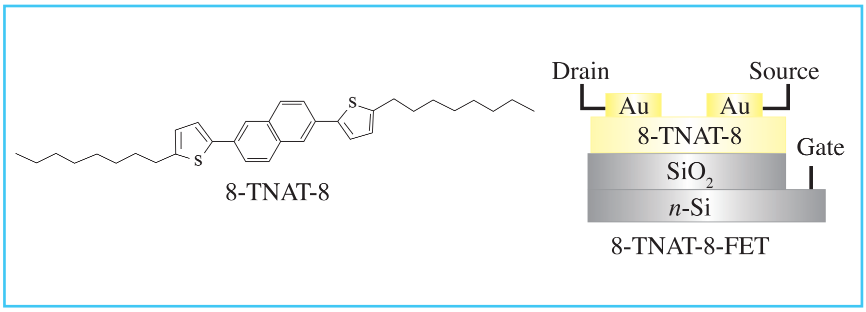

Figure : Chemical structure of the novel mesophase semiconductor 8-TNAT-8 and the FET device geometry