

Design and testing

Tokyo Inst. of Technology: Probing and visualization of charge carrier motion in channels of OFETs

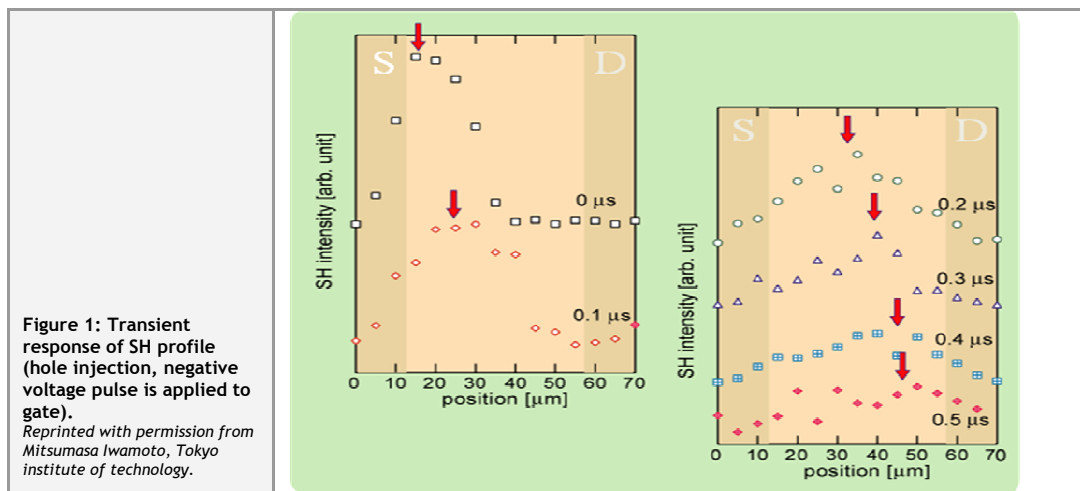
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Visualisation of real charge carrier motion by Second Harmonic Generation technique



M. Iwamoto and coworkers (**Tokyo Institute of Technology**) have elaborated in last years a new method to probe the electric field distribution in channel of organic field effect transistors (OFETs) by microscopic optical second-harmonic generation (SHG) observation [1,2,3,4]. Microspot SHG signals were acquired at various points in the channel with scanning a spot position along source-drain direction.

Recently they have extended this approach, by using advanced SHG technique to probe and visualize real charge carrier motion in organic materials [5]. This is a time-resolved microscopic optical SHG technique that allows direct and selective probing of dynamic carrier motion in organic materials. Experiments making use of this technique and using pentacene OFETs have revealed dynamic changes of second-harmonic-generation intensity profiles arising from pentacene. Carrier velocity in organic solids is thus determined from the visualized carrier motion.



The time-resolved SHG technique enables to evaluate carrier velocity by tracing motion of the SHG peak. Such in situ visualization technique can find several applications in investigations of space-charge field formation in organic and inorganic materials, including biomaterials and polymers.

Direct observation of the space charge formation, electric field distribution and tracking of the moving charges in OFET channel in situ, during the device operation, will allow understanding the influence of charge carrier injection, mobility and trapping phenomena on OFETs performances.

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- [3] "Analysis of carrier injection into a pentacene field effect transistor by optical second harmonic generation measurements"; E. Lim, T. Manaka, M. Iwamoto : *Journal of Applied Physics* 101, 024515 (2007).
- [4] "Probing of electric field in pentacene using microscopic optical second harmonic generation"; D. Yamada, T. Manaka, E. Lim, R. Tamura, M. Iwamoto : *Journal of Applied Physics* 103, 084118 (2008).
- [5] "Evaluation of carrier velocity using time-resolved optical second harmonic generation measurement"; T. Manaka, M. Nakao, E. Lim, M. Iwamoto : *Applied Physics Letters* 92, 142106 (2008).