有機半導体レーザ：電場励起と光励起

Title Organic Semiconductor Lasers: Electric and Optical Excitation

東北大 材料科学高等研究[1]，北京量子信号息科学研究院[2], IISER, India, 東北大院理[4]

○谷垣 勝己[1]，Thangavel Kanagasekaran[3]、三浦大輝[4]、下谷秀和[4]

AIMR, Tohoku Univ.[1], BAQIS, China[2], IISER, India[3], 東北大院理[4]

E-mail: tanigaki@tohoku.ac.jp

Compared to inorganic semiconductors (ISCs), organic semiconductors (OSCs) have many fascinating features such as flexibility, a feasible process, low cost-high performance as well as human-friendly texture. In addition, considering that there are a variety of molecules in OSCs, lasers showing multi-color emission can be anticipated ranging from nearly deep-ultraviolet to far-infrared, and therefore realization of OSC lasers (OSCLs) has been an important, challenging, and cutting-edge research theme in optoelectronics.

Optically-driven solid-state OSCLs (op-OSCLs) have been exemplified, and laser emission with various colors has been demonstrated to date. However, successful operation of electrically driven OSCLs (el-OSCLs) had still been difficult due to the low carrier mobilities as well as the low electron-injection efficiency in OSCs. Recent experiments indicate that the ambipolar carrier injection exceeding ${}^{el}J = 25$ kA cm^{-2} with equivalent hole and electron carriers is possible in an OSC single-crystal FET, which importantly exceeds the ${}^{el}J_{th}$ of 10 kA cm^{-2} considered to be required for lasing in the FET structure of OSCs. Here, we show intriguing experimental data of el-OSCL with FET structure in the cw mode using sc-BP3T as a laser medium, where a very sharp laser emission within the limit of a detector evidently emerges with a nonlinear increase in its intensity above the clear threshold of injection current density (${}^{e}J_{th}$). We compare both electrical and optical excitations for discussing the possibility of lasng.