2. 新しい作動機構に基づく有機エレクトロニクス/スピントロニクス
Organic electronics/spintronics based on novel operation principles

有機エレクトロニクス/スピントロニクスへの関心が近年高まり、実際に役立つ物性として有機半導体特性が再認識されている。しかし有機デバイスの作動原理をみると、無機系のもの焼き直しであることが多く、有機物の弱点である移動度の低さや、電流に対する化学的な不安定性が前面に出てしまう。そこで本研究では、「有機物らしさ」といったキーワードに念頭に、界面電子移動や光電荷分離、キャパシター効果、スピン分極などの研究を通じて、有機/分子系に相応しいエレクトロニクス/スピントロニクスの作動原理を追求し、この分野の新学術基盤を構築する。

There has been a growing interest in organic electronics and spintronics in recent years, and the functions of organic semiconductors have been seen in a new light. However, the operation principles of organic devices are nearly the same as those of inorganic devices, so that the drawbacks of the organic materials, such as poor mobility and chemical instability, often limit the performance of the organic devices. In this project, we will elucidate the characteristic features of organic materials, such as surface electron transfer and charge separation, capacitor effects, spin polarization, etc., and will develop novel operation principles for organic/molecular devices, which are sympathetic to these materials.

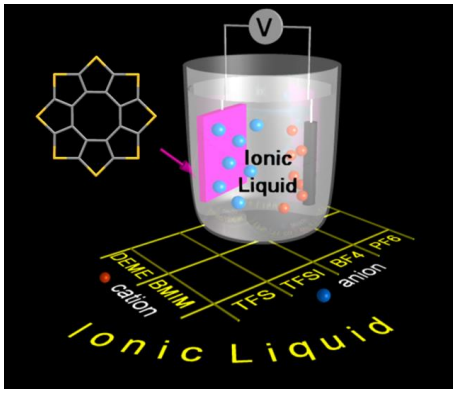

Fig. 1. Electrostatic carrier injection and electrochemical doping of octathio[8]- circulene thin films has been examined for six kinds of ionic liquids using *in-situ* cyclic voltammetry (CV), and conductivity measurements. The performance of the EDL-organic thin film transistors (OTFTs) of octathio[8]circulene demonstrates that the transistor carrier mobility shows a linear decrease with an increase in the capacitance of the ionic liquids. In contrast, the electrochemical oxidation potentials, and the threshold voltage of the EDL-OTFT are governed only by one component of the ionic liquid; namely the electrostatic and electrochemical hole injections are significantly affected by the anions.

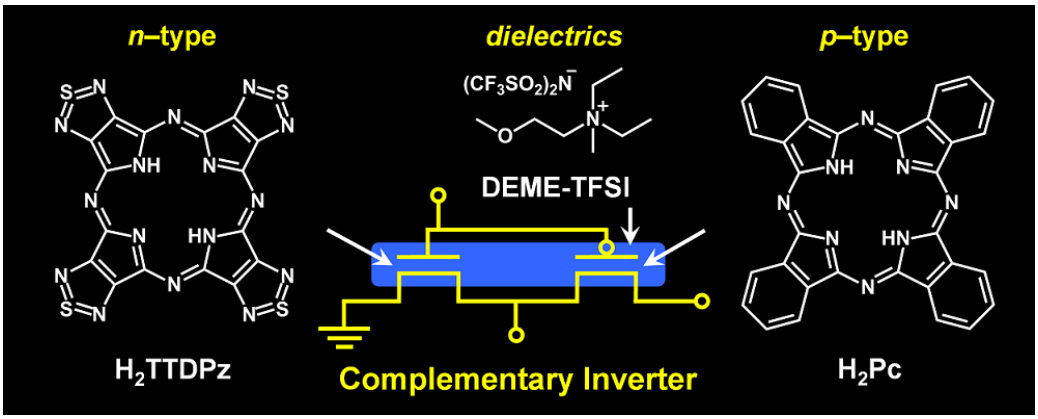

Fig. 2. We studied a complementary organic inverter consisting of *p*- and *n*-type porphyrazine semiconductors, operated through ionic-liquid gate dielectrics.

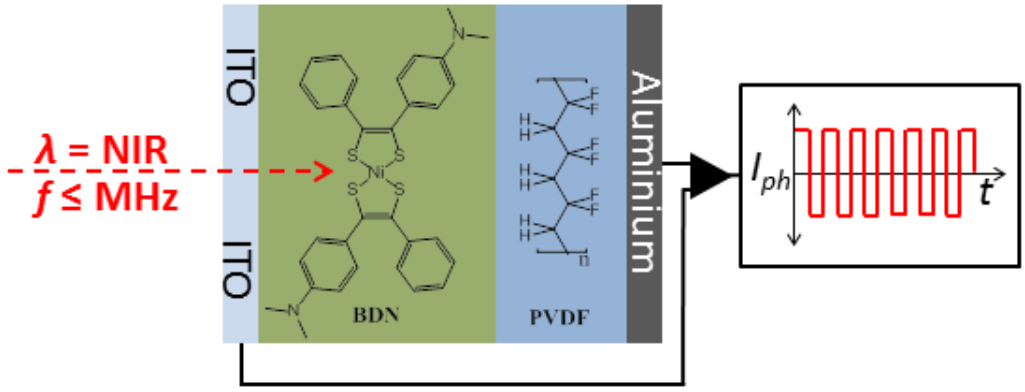

Fig. 3. Photodetection based on bis-(4-dimethylaminodithiobenzil)-Ni(II) (BDN). BDN shows strong absorption in the near infrared region, and has been applied to a metal/insulator/ semiconductor/metal (MISM) structure. The transient form of the MISM photoresponse can be used to detect periodic light signals of frequencies up to 1 MHz, and is thus applicable for optical communications applications.

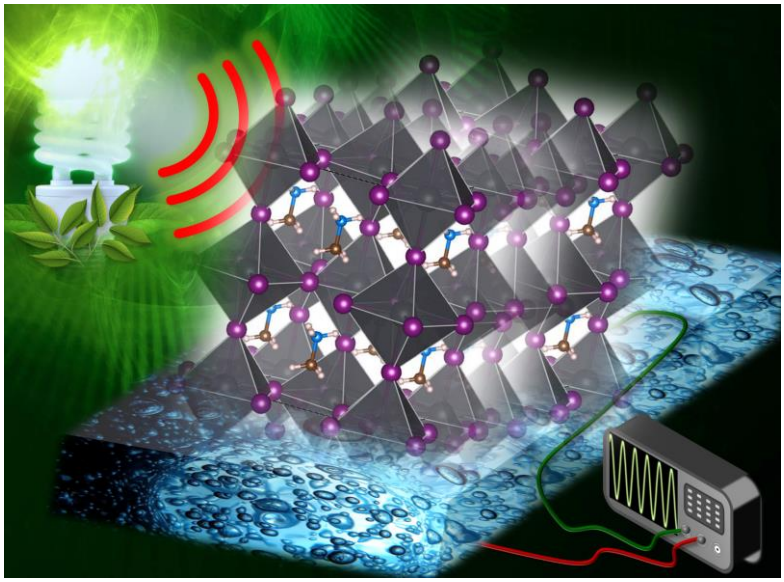

Fig. 4. Transient type AC optoelectronic conversion at the perovskite/ionic liquid interface associated with the electric double layer formation is implemented for energy harvesting technologies. The synergetic effect of ionic liquid and material polarization under pulsed light found to be crucial for the effect formation.

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