Tokodai Institute for Elements Strategy (TIES): Recent Research Progresses

Hideo Hosono : Tokyo Institute of Technology

TIES is the organization for electronic material research in this Element Strategy Initiative to Form Core Research Center. Electronic materials cover insulator through superconductors and use almost all the elements in the periodic table, and large national projects have been carried out so far. Under such a background, our base is doing research along the following policies:

- ◆ Novel approach which rather differs from the traditional based on historical success.
- ◆ Uncultivated issues which experts feel the importance vaguely.
- ◆ Electronic materials for high temperature or high power.

As 5 years have passed since the project started, we had a special symposium for industry to facilitate collaboration in last November. Here several achievements picked up from the recent progresses are introduced;

(1) Apparatus development for trace of hydrogen in materials and elucidation of effect of impurity hydrogen on degradation of oxide TFTs for flat panel displays [1,2]

Hydrogen is the most ubiquitous impurity in materials but almost no extensive research has been performed to date. We focused on this issue and designed a thermal desorption spectrometer with high sensitivity detection limit (~ppm). It was found that impurity hydrogen occupying oxygen sites played a key role in degradation of TFT characteristics under real operation.

(2) Creation of a novel red emitting nitride semiconductor by collaboration of materials informatics, computation and experiment [3]

New semiconductor of $CaZn_2N_2$ was predicted and practically succeeded in synthesis. This is the first example of success by a combination of computation and experiment.

(3) Development of multi-ferroic oxide ($GaFeO_2$), practically workable at RT [4]

(4) Transparent bipolar semiconductors (ZrOS) [5], semiconductors for organic light emitting diodes [6], and high-mobility (~9 cm^2/Vs) p-type amorphous semiconductor (Cu-Sn-I) [7].

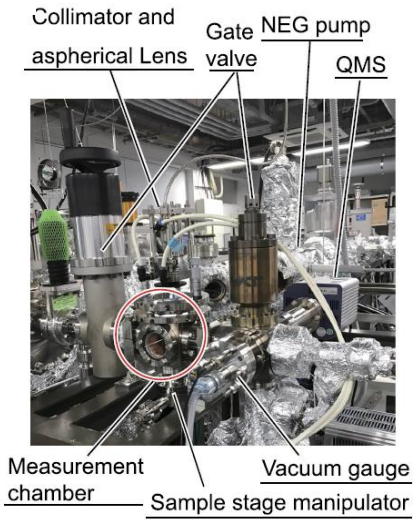

Fig.1. High sensitive TDS apparatus for trace hydrogen in materials [1]

---

[1] T.Hanna et al. Rev. Sci. Instrum. **88**, 053103 (2017), [2] J.Bang et al. Appl. Phys. Lett. **110**, 232105 (2017), [3] Y. Hinuma et al. Nat. Commun. **7**, 11962 (2016), [4] T. Katayama et al., Adv. Funct. Mater. **28**,1704789 (2018), [5] T. Arai et al., J. Am. Chem. Soc. **139**, 17175-17180 (2017), [6] N.Nakamura et al., Adv. Electron Mater. 2018,1700352, [7] T. Jun et al., Adv. Mater., in press.

External link: http://www.ties.titech.ac.jp/