

Template for contributions to  
**‘Recent Research’ of *Tokyo Institute of Technology Bulletin***

Basic requirements

1. The research summary should describe the results of a recent technical paper, which can be accessed in the public domain.
2. In principle, conference proceedings will not be accepted.
3. In areas of research where papers are not frequently published, such as technology management, summaries of new books or conference proceeding will be acceptable. The ISBN numbers should be quoted.
4. The summary should be between 170 to 200 words.
5. The text should be accompanied with a diagram, figure or photograph related to the contents of the publication. Videos, computer graphics, animation, and ‘sound’ files are also encouraged.
6. The Editorial Committee of the *Tokyo Institute of Technology Bulletin* will revise grammar and typographical errors of the text, but the committee will not be responsible for the factual contents of a summary.

Guidelines for preparing a research summary (see the example on the next page)

1. **Title:** This should not be the same as the title of the paper. It should be a simple, eye-catching introduction to the contents.
2. **Background:** The first sentence should be a general description of the field of research. In this example, *the basic properties of zinc oxide* are described.
3. **State the main problem** under consideration. Here, *it is the difficulty in integrating ZnO nanowires with conventional device structures.*
4. A sentence stating the **names of the people (departments)** involved in this research, what they did, and the main results. Here it’s, *Husnu Emrah Unalan and colleagues, who integrated ZnO nanowires into thin film transistors..*
5. A sentence summarizing the **experimental procedure.** Here it is the *three step process* used for synthesizing the ZnO nanowires.
6. A sentence stating the **main results and findings.** Here it is, *the electron mobilities of the ZnO nanowires* and their comparison with other technologies.
7. Final sentence stating the **implications of the results.** Here it is that these results could find *applications for fabrication of large scale devices on flexible substrates.*

## <sup>1</sup> Zinc oxide: Nanowire networks for macroelectronic devices

<sup>2</sup> Zinc oxide (ZnO) is a wide-bandgap semiconductor with a large exciton binding energy, and nanowires made of ZnO are promising for applications such as field-effect transistors and transparent electrodes for solar cells.

<sup>3</sup> However, integrating ZnO nanowires with macroscopic device structures remains a barrier to these applications.

<sup>4</sup> Now, Husnu Emrah Unalan and colleagues at Cambridge University and Rutgers University have shown that highly transparent ZnO-nanowire networks can be used as the active material in thin-film transistors and complementary inverter devices.

<sup>5</sup> The devices were fabricated by a three step process: growth of a dense 'lawn' of ZnO nanowires on gold-catalysed silicon substrates by hydrothermal reduction of ZnO powder at 950 °C; transfer of the nanowire networks to SiO<sub>2</sub>/Si substrates by contact printing; and photolithography to form device structures with niobium source and drain contacts.

<sup>6</sup> The nanowire networks had effective electron mobilities of  $\sim 25 \text{ cm}^2 \text{ Vs}^{-1}$ , compared with just  $\sim 1 \text{ cm}^2 \text{ Vs}^{-1}$  for devices made of amorphous silicon or organic semiconductors.

<sup>7</sup> Networks of ZnO nanowires could find applications as materials for the large-scale fabrication of inexpensive devices on flexible substrates.

### Reference:

- Authors: Husnu Emrah Unalan, Yan Zhang, Pritesh Hiralal, and Sharvari Dalal.
- Title of original paper: Zinc oxide nanowire networks for macroelectronic devices.
- Journal, volume, pages and year: *Applied Physics Letters* **94**, 163501 (2009).
- Digital Object Identifier (DOI): 10.1063/1.3120561
- Affiliations: Department of Engineering, Electrical Engineering, University of Cambridge.
- Department website:

Figure caption: Integrated circuit with ZnO nanowires.



(Figure)