

Patent Analysis and Technology Foresight on Micro/Nano Power Generation

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Introduction

This study conducted a patenting-activity analysis of micro/nano power generation technology, to explore the progress and trends in energy supply technology for micro/nano devices.

Methodology

To figure out the landscape of the Micro/Nano power generation field, quantitative and qualitative analysis methods were both employed, including quantity-based ranking, time-based analysis, selection of core patents, citation analysis, tech-tree analysis, co-classifications, technology development analysis, etc.

Results & analysis

Statistical information

(1) Since 1990, 826 patent applications were published, appearing as three growth periods: a gradual growth from 1990 to 1998, followed by a steady growth from 1999 to 2005, and a very substantial increase since 2006. According to Polynomial regression analysis, 256 applications would be filed in 2010, indicating rapidly growth in patenting.

(2) The major applications were filed in US(367), China(302) and Japan(222). In addition, more than 1/3 of the applications were filed to WIPO through PCT process.

Types of Micro/Nano power generation

The study revealed 7 kinds of power generation: vibration, thermoelectric, photovoltaic, chemical, electromagnetic wave, nuclear and wind. The following trends were shown:

(1) The vibration generation type occupied the largest proportion.

(2) The patenting of the wind, nuclear, photovoltaic and vibration generation types appeared very active, contributing more than 50% of the applications in the last 3 years.

(3) Vibration and thermoelectric applications experienced the highest growth rate.

(4) The US had the largest applications in the generation types of thermoelectric, chemical, electromagnetic wave and wind; whereas China had the largest applications in the generation types of vibration, nuclear and photovoltaic.

(5) The leading players in thermoelectric and nuclear generation types were universities and institutes.

Further analysis of the thermoelectric power generation

Since the rapid growth in patenting recently, the thermoelectric power generation was focused.

(1) Interaction between major research topics

The IPC co-classification between these patents was examined to investigate the penetration and interaction between major research topics. There were two significant patent clusters.

Cluster 1 was about the preparation of thermoelectric semiconductor materials, which integrated the semiconductor technology and the physical, chemical technology. The main topics within cluster 1 were SPS process, hot-press process, hydro-thermal synthesis, electrochemical deposition, physical vapour deposition, chemical vapour deposition, (high pressure) sintering, etc.

Cluster 2 was about the preparation of the precursor of tellurium bismuth-based thermoelectric materials. It was related to the process of powder metal and alloy which belongs to the chemical field.

(2) Tech-innovation focuses of the bismuth telluride-based thermoelectric materials

There were 487 patents related to the bismuth telluride-based thermoelectric materials. Among them, very few were just about the usage of materials in thermoelectric devices. For the rest, 235 focused on the improvements in materials and 234 focused on the improving methods for preparing. The details were shown in Fig.1.

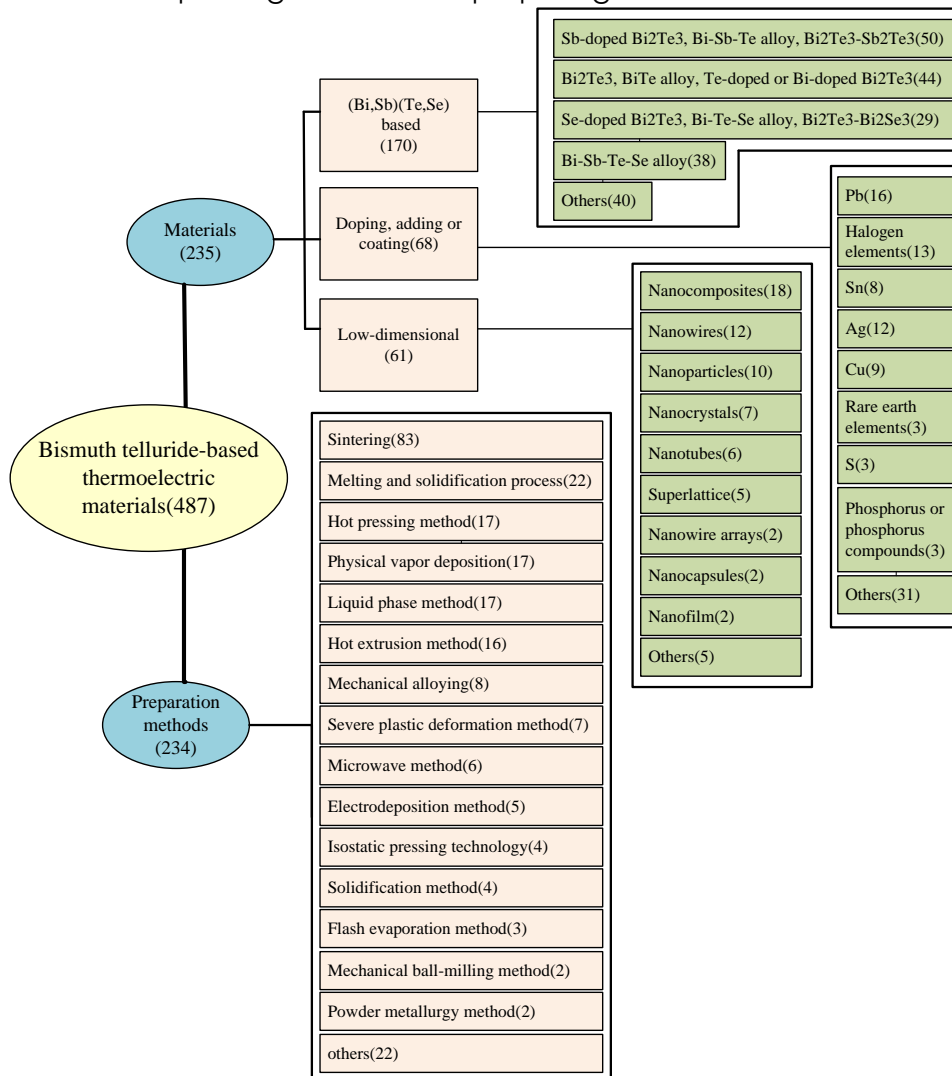


Fig.1 the patent tree of tellurium bismuth-based thermoelectric materials

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