

Research on the Key research Areas Identification and Trace: A Case Study Based on Nano-Optoelectronic Devices Field

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Introduction

How to identify and track the development of S&T, especially the frontier S &T and its trend? What is the key theme of S &T that the world keeps a watchful eye on. These are important aspects in text mining, S &T policy management and development strategy research, and these are also important contents for strategy decision-making support. Exploring the method and technology of mining S &T area' themes and their relationships, then analyzing the trend is our purpose and emphasis.

Nano-optoelectronic devices are not only basic to the further development of microelectronics technology but also a dependent key technology for national security and ICT, energy, light storage, biomedical application and other future strategic economic departments. As a result, major countries/regions are focusing on its R&D. We systematically design the method of mining S&T themes and their relationships. Then we take the nano-optoelectronic as an example.

Methods

We collect a variety of formats and sources of data. And we use the "scientific literature data analysis system" and "Science and Technology Frontier Information Monitoring and Analysis Platform" (STFIMAP) which were developed by ourselves to research on key areas identification and tracking in nano-optoelectronic devices field.

The platform includes functions of dynamic monitoring and tracking different kinds of information (such as web data and paper data in commercial database), knowledge organization and discovery based on ontology, real time clustering and association analysis, etc. we use the function of real-time theme clustering analysis and relationship analysis from STFIMAP and take the SCIE papers and some plans, programs literature of other formats as data source to do an empirical research in nano-optoelectronic devices field.

Process of mining research area's themes systematically: 1) Determine research filed. 2) construct the search query and collect data from Web of Science-extended. There are 18387 papers from 1974 to 2009 in this field. 3) Text clustering: Mainly includes data pretreatment, algorithm implementation, representative words determination and results reveal, etc. 4) Reveal the relationship between the theme and the concept: The "representative words" in each cluster and the "associated words" of "representative words" in the same sentence are used to reveal the concepts and relations between them. 5) Real-time dynamic mining: STFIMAP can be used to adjust clustering parameters and cluster the result again. 6) Visualize the results and interpretation.

Results

The main research results of this paper are as follows:

1. Overview the S &T development strategy and plan of each country/region, the nano-optoelectronic devices mainly involved in the following key fields: nanomaterial, nanoelectronics, nanophotonics, nanobiology and nanomedicine, environment, energy and state security, and the cross-domain with ICT.
2. The paper refines out the strategic investment fields.
3. Analyzed the world's present situation of nano-photoelectric devices development. Analyze the major countries' world position based on scientometric indicators. Through text mining and the words or phrases cooccurrence in a sentence clustering of STFIMAP, the research topics, relationship, and their changing with time are revealed.
4. Combining with the research results of multiple information source, comprehensive analyze the field features and its development trend.

Conclusion

A comprehensive analysis shows that the features and development trend of nano-optoelectronic devices are as follows:

1. All the major countries has inserted nano devices and system into national strategic plan with focused support. Quite a lot of fields have involved into the investment of nano-optoelectronic devices and system research.
2. The Research topic spectrum of nano-optoelectronic devices are wide: from basic research to key material preparation, to innovative nano-optoelectronic devices and to improvement of the performance and application.
3. The development of nano-optoelectronic devices depends on the the development and preparation of key materials. Nano-optoelectronic devices and the key materials will influence each other: nanotubes , graphene ; Silicon III-V and II-VI semiconductor quantum dots and quantum wires; plasmon photonic nanostructures; metamaterials; confinement semiconductor structure, etc.
4. The closely related technology and the photonic devices will support the development of nano-optoelectronic devices. They are top-down techniques; bottom-up technology; nano photon new technology, etc.
5. Nano-optoelectronic devices are typically involved in many areas. The world's important themes of nano-optoelectronic devices field includes the following respects: 1) Nanophotonics, nano-optoelectronics. 2) Nanorods, array. 3) Nano laser devices. 4) The relevant materials, including their features and preparation of nano-optoelectronic devices. 5) The application of nano-optoelectronic devices in energy, medicine, environment , biology and national security.

The results of empirical research are approved by experts of this field and are applied in Chinese Academy of Sciences and Nation's Strategic Planning of Nanotechnology. An effective strategic decision support is provided.

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