

III. Major Research Plan

Major Research Plan is set up by NSFC to guide scientists to conduct innovative research in strategic areas associated with the national long-term scientific and technological, social and economic development. According to the principle of definite objective, stable support, integration and refinement, and leap forward development, NSFC will strengthen the top design, refine scientific objective, promote interdisciplinary studies, create the platform for multidisciplinary cooperation and exchange and stimulate new ideas, emphasize on strategic importance, and provide long-term and sustained support to research groups of projects focusing on the overall objective. Twelve Major Research Plans have been initiated since 2002. In 2006, two Major Research Plans will open to applications. The application time for other Major Research Plans will be announced in the future, respectively.

Basic research on nano science and technology

Nano science and technology are a frontier interdisciplinary area gradually developed since the late 1980s. Nano science and technology have wide ranges of application in information, materials, energy, environment, chemistry, biology, medicine, microelectronics, micro manufacture and national defense, etc., and have become an important frontier of science and technology which draw great attention from scientists of the whole world, and show great potentials of application. Nano science and technology will widely expand and deepen our understanding of the physical world, enable the production of materials and devices at atomic and molecular levels, and bring about technology revolution in such areas as information, material, energy, environment, medicine and health, biology and agriculture. Research and development of this new technology depends on the progress of theoretical and experimental studies in various disciplines, and they will in turn provide new opportunities for the development in these areas.

Scientific goals

Nano science and technology are research areas that develop rapidly in recent years. They are still in the exploration stage both theoretically and experimentally. The “Major research plan of basic research on nano science and technology” takes exploring basic theories and developing new research methods and novel experimental techniques as the starting point, advocates intercrossing multidisciplinary studies, emphasizes on basic research and plans to achieve the following goals:

1. Taking new concepts, new structures, new methods, novel technology and materials as the breakthrough point, it is to make breakthroughs in fountainhead innovation in the theory and experiments for raising the overall innovation capability in research areas of

- nano science and technology, by integrating the theory and methods in modern physics, biological science, information science and chemistry.
2. For making reservations in the long-term development of science and technology in China, it is to solve nano science issues that are of great importance in the progress of science and technology of China, the development of national economy, and the construction of national defense.
 3. Through the implementation of this major research plan, it is to support steadily a number of research talents stationed in China who have creative ideas and active thinking, foster and train a number of Chinese scientists in nano science and technology areas that are recognized domestically and internationally.

In order to realize the scientific goals of the research plan, the following scientific issues will be studied:

1. Nano materials design and preparation. It is to design and prepare nano materials having specific form, composition, structure and specific properties, to study the scientific problems in the preparation process of nano materials, and to explore various possibilities of application of nano materials.
2. New principles and new measures for the characterization of nano systems and micro probing. It is to develop the new concepts, new theories and new methods of characterizing nano system structures and properties, to develop new technologies and new instruments for nano system characterization, and to provide technology support to nano science and technology research.
3. Nano devices and nano electronics. It is to develop the basic theory of nano electron and devices, to construct various nano devices, explore ways of nano device assembly and joint application, and to study their properties.
4. Nano biosystem and bionic nano structure. It is to study the properties of nano biosystem and bionic nano structure, and to explore the application of nano science and technology in medical sciences (diagnosis, drug preparation and gene therapy), agricultural areas, etc.
5. New theory and new methods for nano system construction. It is to study the basic principles of formation and construction of nano system with specific structures, to construct, through system self-organization and manual control, various nano structures, and to provide the basis for constructing various functional nano system and devices.
6. Meso physical foundation of nano system and scientific basis of its special properties. It is to study the scientific basis of various special properties of nano system, and to provide the theoretical basis for research in nano science and technology.

Research contents:

1. Nano materials design and preparation

Relationship between nano materials structure and property, and its stability;
Explorations on the application of special properties of nano materials.

2. New principles and new measures of nano system characterization and micro probing

Dynamic and static characterization of nano structure;
New technology, new principles and new methods of nano structure and property measurement.

3. Nano electronics and nano devices (basic research on nano devices and integration)

Devices based on new principles breaking technical limits of silicon-based microelectronics and their scientific basis;
Nano sensing, detection, storage and display devices.

4. Nano biosystem and bionic nano structure

Biological properties of nano medical materials and bionic nano structures, and biocompatibility;
Basic problems in nano biodiagnosis technology (super high resolution imaging technology, nano biological transducers and nano biological chips).

5. Meso physical basis of nano system and scientific basis of its special properties

Low dimensional effect, surface effect, quantum zone limit effect and quantum transport;
Theoretical problems of meso physics in nano systems.

In 2006, the following areas are encouraged and preferentially supported.

Nano electronics and nano electronic devices

Structure, property design, operation mechanism, manufacture and assembly technology and main parameter and measurement characterization of nano electronics and nano electronic devices;
Structure, property and manufacture and assembly technology of nano electronic logic and computation circuits;
Principles of information processing of nano devices and circuits, including quantum computation and neuro network computation, etc.;
Nano materials for nano electronics and nano electronic devices and property optimization;
New ideas, new phenomena and new effects related to nano electronic devices and circuits.

Nanobiology

Modeling, property measurement technology and bionic applications of bio nano structures;
Model construction and performance of bio nano devices;

Nano targeted transport and slow release of drugs for curing major diseases;
Nano materials used for biomarkers and biological effects;
Technology of earlier disease diagnosis and nano characterization methods.

Informatic mechanism for underlying major life activities of eucaryote

General scientific objectives

This Major Research Plan project takes eucaryote as the research object to understand the informatic mechanism of the following three aspects: inheritance and its derivation, cell differentiation and never transduction, which include scientific issues of information constitution, vector, transduction, modification and regulation. It is designed to select the proper models of biological systems, build up technical platforms with multidisciplinary features, and fund, coordinate and integrate related researches in different disciplines. Through the implementation of the Major Research Plan, it hopes to improve the basic research capacity and quality in genetics, development, cell, biochemistry and neuroscience in China and to achieve research results with original innovation through informatic research of life process. The overall objectives of this plan are:

1. The programmed format and store of genetic information and laws of gene systemized expression existing in the whole genomic sequence of higher organism: the recognition of the coded (protein and nucleic acid) and uncoded sequence in the genome group as well as the identification and categorization of the structural characteristics; the software forecast and experimental confirmation of the genome number and the variable editing number, the biological function explanation of various kinds of DNA sequences (the integration and analysis of the genome and proteomics information, the comparative analysis of the inter-specie and inner-specie genome groups—the comparative analysis of inter-specie homological sequences, inner-specie homological sequences, the allele, the haplotype and SPNs, etc.); the organizational analysis of the genetic expression system (the interactive system between genes, genome and protein, RNAs, and genes and various regulative components), the biological explanation of the acting law and genetic expression results.
2. The clarification of informatics mechanism and process of cell, including 1) genetic information base of cell differentiation and its expression regulation: to monitor gene expression profile related to cell differentiation process, to find related genes and the expression regulation mechanisms taking the key function in controlling cell differentiation and the maintaining mechanism of differentiation state, and to identify necessary factors maintaining non-differentiation state of a totipotent or pluripotent stem cells and differentiating into a special functional cell in order to realize the controllable cell differentiation; 2) research on the channels of information transduction in cell differentiation: to identify information transduction molecules expressed specially in

each differentiation phase of a normal cell so as to discover new factors, to understand the interaction between different signal pathways in cell differentiation, to construct virtual cell models and websites to provide information service for the research of information transduction pathways, and to perform virtual experiments.

3. Informatics mechanism and molecular biology base of neural information processing
Since the fund is limited, application related to neural information will not be accepted temporarily from 2005 to 2006.
4. Theoretical exploration on physical and chemical regulations and new technology application in major life communication process: the illustration of major scientific issues in major life information processes through applying physical, chemical, mathematic principles and laws which fit non-living world universally; the exploration and application of various new technologies, such as real-time monitoring and emulating techniques of cell, new types of cell dyes and markers, instant image taking, emulating and virtual imitating, etc.

Application status in 2005 and the main supporting research directions in 2006

The total funding was 3.15 million yuan in 2005 for 8 projects, with an average funding of 393,800 yuan per project. An additional 5.40 million yuan was given to 15 projects approved in 2002 that have made good progress. Another 400,000 yuan was kept for projects administration. The total budget is 8.95 million yuan.

The following areas will be supported by the plan in 2006:

- 1) The structural format of genetic information compiling in genome and informatics characters and functional analysis of coding elements and non-coding sequences;
- 2) Relevance and systematic analysis of transcription group and proteomic group information;
- 3) Factors concerned in the channel of molecular signal transduction and their functions using proper model animals;
- 4) Energy characteristics of bio-information and information transduction of eucaryote, including the changes of chemical energy and physical energy and their interrelation.