Major Research Plan

Following the principle of definite objective, stable support, integration and refinement and leap forward development, Major Research Plan projects focus on key basic scientific issues with strategic importance to the country and major frontiers in the areas arranged on the basis of the capability and advantages of the country to form groups of projects with relatively identical objectives for assembling innovative research resources in order to realize the leap forward development in certain key areas.

Applicants should have the following eligibilities:
1. Experience of undertaking basic research projects;
2. Senior academic position (title).
Researchers who are working in post-doc stations or graduate students are not qualified to apply.

Major Research Plan provides three types of funds for projects: “fostering project”, “key funding project” and “integrated project”. The fostering project is a 3-year research project, and key funding project and integrated project are 4-year research projects. Proposals for fostering project and key funding project may be involved by no more than two more collaborating institutions. Proposals shall be written in accordance with the requirement for Major Research Plan and outlines for proposals of Major Research Plan projects, provide with the features of interdisciplinary research, and emphasize on the contributions to solving key scientific issues and fulfilling the overall goals of the Major Research Plan concerned. Please select “Major Research Plan” for the column of the funding type in the form of proposal, and fostering project, key funding project, or integrated project for the column of sub type in the form of proposal, and the titles of the Major Research Plan concerned in the annotation. The proposal will be not accepted in case of incorrect selections or without any selections.

Fund for projects of Major Research Plan is no less than 500,000 yuan per project (except projects for “emergency management of unexpected events” which is 350,000 yuan per project). Please apply for other programs according to actual needs if the proposal requires less than the minimum funding of the Major Research Plan projects.

Studies on the Destruction of North China Craton

This Major Research Plan aims to understand and reveal the significance of the Craton destruction to the formation of the continents and the interaction among the Earth’s spheres through the investigation of North China Craton destruction, and to further

provide new ideas and scientific bases for the strategic prediction of resources and the precaution of earthquake hazards.

I. Scientific targets

From the viewpoint of the Earth's system sciences, by integrating observations, experimental and theoretical achievements made by new and high technologies, prospecting methods and analytical approaches of modern earth sciences, mathematical and physical sciences and information sciences, the Plan is (ⅰ) to understand the temporal-spatial distribution, processes and mechanism for the destruction of North China Craton, (ⅱ) to investigate the character and structure of different spheres in the Earth's interior and their interactions, (ⅲ) to determine the effects of cratonic destruction on shallower spheres and their control mechanisms for mineral resources, energy sources and disasters, and (ⅳ) to further improve our understanding of the formation and evolution of the Earth's continents.

II. Key scientific issue

The key scientific issue is the destruction of the Craton.

III. Funding principles and key research areas in 2010

The Major Research Plan is approaching to its mid stage. Based on the decision of the Steering Group, the key funding areas and implementation during the mid- and late stages are (ⅰ) to strengthen integrated research, and the number of new projects should be moderate, (ⅱ) to enhance the construction of scientific data center, and (ⅲ) to actively carry out various academic exchanges in order to efficiently promote interdisciplinary collaboration and substantial cooperative researches.

1. Funding principles in 2010

(1) Research focusing on key scientific issues of the Plan;
(2) Innovative research with new ideas;
(3) Interdisciplinary researches and international cooperation.

2. Key research areas in 2010

(1) Comprehensive integration of petrology and geochemistry according to the disciplinary trends and the implementation of the Plan;
(2) Linkage between biological evolution and the destruction of North China Craton;
(3) Numerical simulation of the destruction of North China Craton;
(4) New methods to deepen the scientific issues.

Key Basic Scientific Issues in Near Space Aircraft

The development of near space vehicle is related to the national security and peaceful use of space. It is one of the key issues of space technology in the world, and reflects the comprehensive strength of the country. This Major Research Plan will focus on key scientific issues in near space vehicles, through interdisciplinary research, to improve China's innovative capability in the research on near space vehicles and to establish the foundation for technology innovation in the development of near space vehicle in China.

I. Scientific targets

With the focus on key basic scientific issues of near space hypersonic long range maneuverable vehicle, the study may achieve the following targets in the areas of aerodynamics of near space flight environment, advanced propulsion theory and methods, super light materials and structures, thermal prediction and protection, intelligent autonomous control theory and methods for hypersonic aircraft, etc.: (ⅰ) Developing the innovative theory and methods for solving key scientific issues in near space vehicle and providing the basis for theory and methods in the research and development of relevant technology concerned in China; (ⅱ) Making innovative breakthroughs to some extent in the development of technical methods to improve the indigenous capability of the country in relevant areas for leap forward development of technologies concerned; (ⅲ) Fostering a team of outstanding researchers with the theoretical and indigenous innovative capabilities working in the area and promoting the establishment of a number of interdisciplinary basic research platforms to support sustained development of technology in the filed of near space vehicle in China.

The Plan focuses on scientific issues related to near space hypersonic long range maneuverable vehicles at the altitude of 30 to 70 kilometers, and breakthroughs are expected in the following areas:

(1) Flight theory and methodology of the vehicle referring the integration of aerodynamic and centrifugal forces;

(2) Thermal environment in long time near space flight and theory and methodology of non ablation thermal protection;

(3) Mechanism and methodology of propulsion related to supersonic combustion;

(4) Coupling mechanism and prediction methods of high temperature, non-equilibrium, viscous interference, rare gas and turbulent effects;

(5) Theory and methodology of experimental and numerical simulation of near space flight environment, and coupling theory and methodology of CFD and computational structure dynamics;

(6) Unified optimum designing methods for material and structure, new super light multi functional materials and new configurations;

(7) Thermal and strength coupling response mechanism of materials, and designing theory and methodology of thermal protection structure;
(8) Intelligent autonomous control theory, and flight theory and control method of variable body.

II. Funding areas and directions, and key funding projects in 2010

1. Aerodynamics of near space flight environment

(1) Basic problems and multidisciplinary optimization of hypersonic flight
Mechanism and aerodynamic characteristics prediction of high temperature, non-equilibrium, viscous interference, rare gas effect and turbulent coupling effect in near space hypersonic flight, and the theory and methods for multidisciplinary optimization of aerodynamic forces, aero thermodynamics, propulsion and electromagnetic properties.
(2) Thermal environment prediction and thermal protection
Thermodynamic environment prediction of long time flight in near space, and new principles and methods for non-ablation thermal protection.
(3) Maneuver of hypersonic aircrafts
Principles and methods of aircraft maneuvers at wide Mach number range, and aerodynamic physics in reentry.

2. Advanced theory and method of propulsion

(1) Supersonic combustion mechanism
Theory and methods of supersonic combustion, interaction of supersonic flow and combustion, high efficiency integration of air intake and exhaustion, thermal protection of combustion chamber and solid fluid coupling problems in thermal environment.
(2) Ground test simulation and flow field diagnosis
Diagnosing method for supersonic combustion process, and theory and methods of combustion performance evaluation.
(3) New theory and method of propulsion
New theory of propulsion, and theory and methods of new concept propulsion.

3. Light and high heat resistant material and structure, and thermal response prediction and thermal protection

(1) New light material, new configuration and unified optimal design of material and structure
Focusing on light heat resistant and isolation materials and structure, to conduct research on methods for unified design of structure and function, and preparation and representation method of new materials and the designing theory and method of multidisciplinary optimization.

(2) Non-ablative thermal protection materials at super high temperatures

Principles and design methods for anti oxidation, ablation resistance and stiffness enhancement of non-ablation materials at super high temperatures, new system and preparation of non ablation super high temperature materials, and the response mechanism of non ablation super high temperature materials in working environment.

(3) Thermal protection and thermal structure

New theory and mechanism of active and passive integrated thermal protection, thermal environment and structure analysis and design method of computational fluid dynamics coupled with computational structure dynamics, and experimental methods for material high temperature mechanics and thermal response of structures.

4. Theory and methods for hypersonic vehicle intelligent autonomous control

(1) Flight control of hypersonic vehicle with coordination of stability and maneuverability

Aircraft dynamic modeling and verification of controls, coordinative control of propulsion, attitude, aero-thermodynamics, uncertain nonlinear intelligent self-adaptive control, coordinated control of strong coupled non-linear system, composite control of mixed type multi vertical surfaces and the high reliable control of fault-tolerant, and methods of self acquisition of information under highly dynamic media moving conditions.

(2) Structure control of hypersonic vehicle

Dynamic modeling and simulation of aircraft structures, analysis of aircraft stability and complex motion, analysis and control of structural vibration, control of servo aero-elasticity and flutter, and analysis and control of structural dynamics at high temperatures.

(3) Aerodynamic theory and control method of variable body flight

Aerodynamic principles of variable body vehicle and prediction of aerodynamic characteristics, and mechanical modeling and control of the structure of variable body aircraft.

5. Key funding projects to be funded in the following areas in 2010:

(1) Flows coupled with viscous interference, rare gas effect and non-equilibrium effect;

(2) Maneuver flight and unsteady flow;

(3) Theory, method and process diagnosis of supersonic combustion;

(4) Thermal environment prediction in near space flight;

(5) Non ablation material and response to servo environment;

(6) Coupling theory and simulation method of aero thermal/material/structure;

(7) Modeling and verification for the integration of aircraft dynamics and control;

(8) Intelligent self-adaptive control of aircraft structure and flight.

Proposal for key funding projects should focus on the themes of near space aircraft in

long-range hypersonic maneuverable flight, and the research direction may be decided by applicants themselves according to the above areas. Interdisciplinary research among the above-mentioned four funding areas and experimental studies are encouraged for making breakthroughs pertaining to basic theory, principles and methods. Study on the mechanism of engine supersonic combustions will be strengthened. The research group should have at least 5 researchers with senior professional titles.

III. Funding budget and projects in 2010

Applications for the Plan will be accepted during the period of 5 years and funded as the fostering projects and key funding projects. More than 500 thousand yuan will be provided to each of the fostering projects having innovative ideas at the initial stage and as high as 800 thousand yuan to each of the projects focusing on the experimental research. For key funding projects, about 3 million yuan will be provided to each of the projects with good research foundation, clear and important scientific issues for further exploration and characteristics of interdisciplinary studies.

In 2010, a total budget of 43 million yuan is planned for about 20 three-year fostering projects (from January 1, 2011 to December 2013) and about 8 four-years key funding projects (from January 1, 2011 to December 2014).

Single Quantum State Detection and Its Interactions

Since the establishment of quantum mechanics, the understanding about the laws in the microcosmos has been gradually deepened and the development of modern science and technology hence has been greatly promoted. Up to now, the understanding has been confined to a large extent in the sense of statistics, in particular, research on the precision measurement of single quantum state and its interactions is still at initial stage, which affects the development of contemporary physics with quantum mechanics as its central part, and other disciplines concerned as well. In recent years, along with the development of the experimental precision and control technology, some of single quantum state system may be established and the physical characteristics could be directly detected. Therefore, great breakthrough may be fostered from the research concerning single quantum state as the interdisciplinary development with information, material, energy and chemistry.

Single quantum state refers to quantum state of single particles in the quantum system, such as single photon, single electron, single atom, single molecule and sub particles in condensed matter, etc. and macro quantum state formed by multi particles (such as

Bose-Einstein condensed state, super conductivity or super fluid quantum state). This Major Research Plan aims at developing relevant materials and systems by physical and chemical means, constructing single particle quantum state and macro quantum state and detecting directly its quantum state and quantum effects so as to understand the property of quantum state and basic laws of quantum process, develop new techniques of constructing quantum devices and means of quantum detection, explore potential applications in information and energy technology, promote the development of basic research of China in the fields of physics, chemistry and information technology, and solve some basic science and key technology issues in the major national strategy.

I. Scientific targets

(1) To develop physical and chemical methods and technology for relevant materials and systems, construct high quality quantum structures as well as new precision detection methods for understanding the mechanism of relevant phenomena and processes at single quantum state, and to discover several novel quantum effects through the measurement of single quantum state and study of interaction between quantum states;
(2) To provide solid physical basis for the application of quantum effect in the studies on major scientific issues from information technology, energy and environment, and farsighted knowledge for leapfrog and sustained development of national economy and security;
(3) To form gradually the Chinese school with international reputation and foster a high level research team, especially a number of outstanding young scholars engaging at experimental science for promoting the competitiveness and position of experimental science in China.

II. Key scientific problems

1. Physical and chemical preparation of relevant material, and the construction of single quantum system;
2. Property and precision detection of single quantum state system;
3. Quantum state and environment, and interaction between quantum states;
4. Modeling and numerical computation of quantum state interaction.

III. Key funding research areas in 2010

In 2010, scientists are encouraged to submit applications targeting at specific scientific problems in the following funding areas.

1. Physical and chemical preparation of relevant materials, and the construction of single quantum state system

Using various physical and chemical methods, to prepare high quality materials for

constructing various single quantum state systems, including quantum states such as single electron state, single photon state, single self spin state, single molecular vibration and rotating quantum state, and orbit quantum state, etc., and to complete the preparation of materials and structures of the single photon source and the materials of macroscopic quantum state.

2. New principle and method of precision detection of single quantum state

The principle and technology of spectrum and spectroscopy for high resolution, high sensitivity of time, space and energy at single atomic and single molecular scale; the evolution of energy level and wave function of single quantum state; the detection of single molecule vibration and rotating quantum state and orbit quantum state, the measurement and control and ultra fast dynamics as well of self spinning single quantum state; the development of spin-resolved energy spectrum, wave spectrum and scanning probe and other integrated detection methods; and new methods and technology of single photon measurement at different wave band.

3. Coupling between quantum states and interaction with environment

Preparation and measurement of coupling quantum state such as exciton-photon, electron-electron, electron-photon, etc in the restricted system; chemical reaction and the selection and control of energy transfer channels of different molecular quantum state; new methods and coherence for generating quantum entanglement (photon, electron, atom and molecule entanglement); the integration and coherence control of qubits; the generation, transportation and interaction of surface plasmon; the generation and variation of surface electron excitation state and interaction of photon and electron; and the evolution of single quantum state in the outfield.

4. Quantum state and quantum effect in condensed state matter

Preparation, representation and characterization of new system of macro quantum state, competition of multi ordered state and quantum phase change, quantum Hall effect and topological excitation; quantum effect or quantum transport of interface or surface single quantum state in compound system and other functional characteristics, and new phenomena and new effect of cold atom condensed system.

5. Modeling and numerical computation of quantum state interaction

Basic laws and theory of single quantum state and interaction; theoretical model and computational method related to single quantum state preparation, measurement and characteristics, and new computational method beyond single particle approximation.

A total budget of 150 million yuan will be provided for 8 years. The research projects will be proposed and funded within the first five years. In 2010, the budget is about 31 million yuan. The average funding of key funding project is 3 million yuan per project

for 4 years, and fostering project is 700,000 yuan for 3 years.

In 2009, 57 proposals were received for the Plan, among them 46 proposals are for fostering project and 11 proposals for key funding project. After panel evaluation, 4 key funding projects and 11 fostering projects were funded with a total funding of 19 million yuan.

IV. Funding priority

(1) New concepts and methods of material preparation and measurement focusing on single quantum state system based on experiments;
(2) Theory and simulation that can greatly promote the development of experimental work in China;
(3) Reasonable technical route with creative academic ideas;
(4) Good background and working accumulation related to research;
(5) Important roles in accelerating the overall development of the Major Research Plan and understanding key scientific problems.

Structural Design and Controllable Preparation of Function Oriented Crystal-state Materials

Crystal-state materials are the sum of long-range ordered solid materials, which have the following features: stable ordered structure, clear relation of structure and efficacy, diversified essential properties, enriched physical intension and easy compound and regulation. Studies on crystal state materials focus on the functional orientation and material development needed for special performance by structural design and controllable preparation.

I. Scientific targets

The Major Research Plan is to explore the functional elements that decide macro-properties of crystal-state materials and their integrated ways in the space, to develop the theory of functional elements and to deepen the understanding of the functions of materials and natures of functional elements, based on the internal relation between macro-properties (optic, electric, magnetic and complex property) and micro-structures (electron, molecule and aggregation) of crystal-state materials. It is also to conduct research and applied work on the design, synthesis, preparation, characterization of functional crystal materials and to provide new theory, methods and material systems for realizing the structural design and controllable preparation of crystal-state materials guided by function, as well as to promote the development of

relative disciplines.

In order to realize the above targets, applicants should give full play to the superiority of intercrossing and cooperation of multi-disciplines, such as chemistry, physics, materials and information sciences, lay stress on the creativity and research in the cutting edge areas, and foster talents and research teams with international reputation for making great contributions to the national economy and social sustainable development.

II. Key scientific issues

There are three key scientific issues: key functional elements which decide the properties of crystal-state materials, the relationship between macro-properties and micro-structures of crystal-state materials, and the design principle and the controllable instruments for the preparation of crystal materials based on the functional elements.

1. Functional elements, structure-activity relationship and its law of crystal-state materials

Focusing on the structural features of functional elements in the crystal-state materials, the following research work will be encouraged:

To establish and develop new theoretical methods, to calculate, simulate and predicate the structures and properties (such as magnetic, electronic and optical properties) based on multi-levels and multi-scales for exploring the origin of functional features and key functional elements in the crystal-state materials.

To reveal the interaction (such as covalent bond, ionic bond, coordination bond, hydrogen bond and weak mutual action, etc.) of the functional elements (electron, atom, ion, molecule, group, domain structure and phase structure, etc.) in crystal-state materials and the relationship between crystal-state materials and their properties (including optic, electric, magnetic and complex function), for exploring the relationship between macro-symmetry and property of crystal-state materials.

To study systematically the assembly, modification and regulation of optic/electric/magnetic properties of crystal-state materials, to observe the physical echo of relative systems under outside disturbance (e.g. magnetic, electric, optic, thermometric, force field, etc.), for probing the basic issues, such as electron transportation, magnetic order, conversion of energy, etc and finding the regulative and controllable means in application..

2. Design of new function oriented crystal-state materials

It is to design and synthesize new crystal-state materials according to the relationship and

laws between structure and property. The following research work will be encouraged:

To develop the methodology of "molecular engineering" and "crystal engineering" based on the theory of functional elements and materials system, and to carry out the study on the computational materials science for guiding the design of materials.

To design and synthesize the materials system with key functional elements and special structure, and to study their features, such as non-linear, laser, luminescence, electric, magnetic, composite property, etc., for revealing the relationship between structure and property as well as finding new functional crystal-state materials.

3. Controllable preparation and characterization of new crystal-state materials

It is to develop new methods of synthesis, preparation and characterization. The following research work will be encouraged:

To develop the assembly method and technique of functional elements and the preparation of newly functional materials by the structural optimum and tailoring of functional elements, and to realize the strengthen and composition of function by the controllable growth of crystal-state materials with special structures achieves by means of regulative and controlling structure.

To develop new synthetic methods under extreme conditions, especially the preparation technique of sub-stable phase crystal-state materials, film and interfacing structural materials.

To establish new surveying and characterizing means of functional elements and their materials, with focus on the techniques of *in-situ*, in time, micro-area structural materials, as well as the characterization of crystal-state materials. It is encouraged to carry out the study of property and mechanism of crystal-state material in the state large scientific facilities concerned.

4. New function oriented crystal-state materials

Based on the research superiority in the areas concerned in China, and the above-mentioned research issues, studies will be encouraged in the following areas:

(1) Optic and luminous materials: to study the laser and non-linear optical materials with new wave band and new structural type, sunlight and upper conversion luminous materials, and optical and luminous materials based on coordinated compounds and artificial micro-structures, etc.

(2) Electric and magnetic functional materials: to study non-metal crystal-state materials of new structures with electric and magnetic functions, especially photoelectric, piezoelectric and magnetic materials, etc.

(3) Complex system and functional composite materials: to study the functional and composite functional materials in the complex systems with the interaction between electric charges, self-spin, orbit and lattices, especially non-conventional superconductor materials, new magneto-electric resistance materials, huge thermoelectric materials, photo-electric conversion materials, photo-functional composite materials, etc.

III. Projects to be funded in 2010

In 2009, 140 proposals were accepted for the Plan, in which 36 proposals were for key funding projects, 97 for fostering projects and 7 proposals were not in keeping with the requirement. The proposals cover 14 disciplines in 5 departments. 8 key funding projects and 29 fostering projects were funded, with a funding of 18.86 million yuan and a funding of 14.5 million yuan, respectively.

These projects basically reflect the scientific targets and research directions assigned in the Plan and are started smoothly. Some of the proposals however did not incarnate the function-oriented and structural design requirement, therefore, this requirement must be stressed this year. Proposals for nano-materials will be not accepted because another special fund is provided.

The Plan will provide two types of funds: key funding project and fostering project. Proposals with creative idea will be funded by fostering project. Proposals which have excellent research background and working experience as well as clear scientific issues and interaction between chemistry and other disciplines will be funded by key funding project. All proposals should meet the requirement to the function orientation and structure design.

In 2010, about 30 fostering projects will be funded with more than 0.5 million yuan each for 3 years and 8 key funding projects will be funded with about 2.5 million yuan each for 4 years. The total budget for the Plan is 35 million yuan this year.

IV. Principles of project selection

In order to realize the overall targets of the Plan, the following studies will be encouraged:

(1) Exploratory studies with original creative ideas and/or unique features;

(2) Studies on the key scientific and technical issues closely related to the overall target;

(3) Intercrossing and cooperative studies among chemistry, mathematics and physics, materials, information discipline, etc;
(4) Studies with the participation of overseas excellent scientists.

Fundamental Research on Nanomanufacturing

Nanomanufacturing and its science are the key basis for applications in nanoscience and nanotechnology. The Major Research Plan focuses on the frontiers of fundamental research on nanoprecision manufacturing, nanoscale manufacturing, and multiscale manufacturing to meet key strategic demands of the national development, to explore the energy-motion-structure-property interactions and processing mechanisms when manufacturing processing size shrinks from macroscale to microscale, to establish fundamental theories, techniques and equipment mechanisms of nanomanufacturing and to forest excellent researchers in the area, as well as to promote original creativity and develop internationally broad-impacting results.

I. Scientific targets

Through the interaction and merging of related disciplines such as mechanical engineering, physics, chemistry, biology, materials science and information science, the Plan aims to (ⅰ) explore the novel nanomanufacturing methods and techniques based on physical/chemical/biological mechanisms; (ⅱ) reveal the size-dependent phenomena and interfacial effects during nanoscale/nanoprecision manufacturing, molding, modification, and multiscale manufacturing; (ⅲ) illustrate the mechanisms of materials structural transformations and formation laws of device functions; (ⅳ) establish high-precision characterization and measurement methods during nanomanufacturing; (ⅴ) develop novel nanomanufacturing techniques and equipment mechanisms, and (ⅵ) provide A theoretical basis for nanomanufacturing repeatability and mass production.

II.Overall schedule for the Plan

By following the principles of limited objectives, stable support, integrated improvement and leap-forward development, the Plan focuses on two types of fundamental scientific nanomanufacturing research: (ⅰ) topics related to major strategic demands of national development, and (ⅱ) major scientific frontiers in the area.

The Plan is expected to last 8 years with a total budget of 150 million yuan. Proposals will be accepted mainly in the first five years for three types of funds: fostering projects, key funding projects, and integrated projects:
(1) Three-year fostering projects provide support for proposals with innovative ideas on nanomanufacturing fundamental frontiers;

(2) Four-year key funding projects provide support for proposals with significant innovative ideas and solid research background, as well as good chances of great breakthroughs;
(3) Four-year integrated projects provide support for proposals with solid background that will make significant contribution to the achievement of the overall objectives. The call for proposals will be properly arranged during the late stage of the Plan.

III. Selection criteria

All projects under the Plan shall meet the following criteria:
(1) They should meet the key strategic demands of the national development in frontiers of nanomanufacturing fundamentals with emphasis on the characteristics of nanomanufacturing;
(2) They should focus on nanomanufacturing science and key technologies. Interdisciplinary proposals are encouraged. Proposals for key funding projects shall involve merging and collaboration cross-related disciplines such as mechanical engineering, physics, chemistry, biology and information science to develop novel mechanisms, methods, technologies and processes of nanomanufacturing;
(3) Originally exploratory research is encouraged;
(4) Concrete international cooperation is encouraged.

IV.Funding priority in 2010

1. Nanoscale manufacturing based on physical/chemical/biologic mechanisms

Novel nanomanufacturing methods and techniques on nanostructure formation, machining, modification and assembly, and the dynamics and performance of structures and devices.

2. Nanoprecision manufacturing of macrostructures

Novel mechanisms, methods and techniques of nanoprecision of macrostructures, atoms/molecules transportation mechanisms and surface/interfacial effects, and nanoprecision surface treatment theories.

3. Nano/Micro/Macro (multiscale) manufacturing

Novel mechanisms and methods of multiscale manufacturing, interfacial behavior and multi-field regulation during multiscale manufacturing, and arrangement, control and integration of multiscale structures and devices.

4. Precision and measurements of nanomanufacturing

Nanoscale measurement trace and error evaluation, nanomanufacturing precision design

theories, measurement of characterization of nanostructure geometric parameters, and mechanical properties.

5. Novel mechanisms of nanomanufacturing equipments

Microperturbation, non-linear dynamics and response distortion, modes of energy conversion and process controls during nanomanufacturing, novel drive and control of nanoprecision motions.

V. Funding information in 2009

In 2009, 233 proposals from 86 institutions were received on nanomanufacturing, including 190 for fostering projects and 43 for key funding projects. 11 proposals were rejected due to various format reasons. 222 proposals were sent for reviews. Through peer review and panel evaluation, 42 proposals were funded with a total of 33.96 million yuan, including 6 key funding projects with 15.80 million yuan and 36 fostering projects with 18.16 million yuan.

VI. Proposed budget and projects in 2010

The 2010 budget is 35 million yuan for 40 fostering projects (> 0.5 million yuan for 3 years), and 5~7 key support projects (about 2~3 million yuan for 4 years).

Research on the Unconventional Emergency Management

With unconventional emergency management as the research object, this Major Research Plan encourages multi-disciplinary collaboration among management science, information science, psychological science, etc., focuses on information processing and evolution modeling for unconventional emergencies, unconventional emergency decision-making theory, and psychological reactions and behavior patterns of individuals and groups under emergencies, and integrates research results by means of the integration platforms established in the Plan. Unconventional emergencies are defined in this Major Research Plan as those devastating emergencies that are marked by salient complexity and potential secondary-derivative hazards, and cannot be sufficiently predicted and coped with by conventional management practices.

I. Scientific targets

This Major Research Plan is aimed at the formation of incisive understanding of the underlining laws governing key procedures such as monitoring, early-warning and response decision-making in non-conventional emergency management through relevant

multi-disciplinary observation, experiment, theoretical innovation and integration, and at providing scientific methods. The construction of "scenario-reply" based theoretical system of unconventional emergency management, the enhancement of independent innovation ability in emergency management science and technology, and the establishment of a scientific national emergency management system (including emergency platform/response planning system) are also encouraged in order to provide suggestions and references for the government decision-making in scientific, efficient and orderly response to non-conventional emergencies. Researchers are encouraged to nurture intercrossing disciplines in emergency management science, to foster innovative talents, and to play a key role in the international arena of emergency management science.

II. Key scientific issues

1. Information processing and evolution modeling of unconventional emergencies

With respect to the premonitor and the massive, heterogeneous, real-time data during the process of unconventional emergencies, research should focus on scientific issues concerning the collection, data analysis, dissemination, visualization, and sharing of information. Theoretical and methodological researches on the nontraditional (such as data-driven or computational experiment based, etc.) complex modeling of the evolution of unconventional emergencies are also expected.

2. Unconventional emergency oriented decision-making theory

Studies on theoretical methods for whole-course dynamic assessment, analysis and decision-making in on-site unconventional emergency response decision-making, studies on organizational design, operation and evaluation theory and methods for emergency preparation system, decision-making and command systems, rescue/implementation system, and resource mobilization system, studies on the design of emergency response platform, preplanning system, and training methods, studies on comprehensive decision support theories and methods for multi-event coupling and scenario construction, and theories and methods for the integration of hardware and software systems.

3. Individual and group psychological and behavior responses under emergencies

Studies on the psychological mechanisms (cognitive, emotional, mental attitude, demand, etc.) of the major participants (including managers, rescue workers and the general public) as individuals under stressful emergencies, as well as laws and structural features of group behavior under emergencies.

III. The establishment of the integrated platforms

1. Unconventional emergency dynamic simulation system

A whole-course scenario construction and modeling prediction of unconventional emergencies are conducted through complex system modeling methods (e.g. social computation, complex networks, etc.), computer simulation and network communication technologies and the integration of information modeling theory and methods and personal psychological behavior pattern, to establish a distributed, visualized dynamic simulation system for unconventional emergencies. Academically, the platform can be used as a long-term experimental tool for theoretical studies. Pragmatically, the platform can be used as an auxiliary technical reference tool for unconventional emergency decision-makings.

2. Basic platform emergency response system

Based on public security S&T and information technology and with respect to emergency management process, a basic platform emergency response system will be established by the combination of hardware and software, including information processing, process evaluation, comprehensive judgment, decision support and other basic functions. The basic platform should be able to integrate and validate relevant basic research results, form a visual guide for the implementation of emergency response plans, and build up an integrated decision support platform. Meanwhile, the platform can also be used as a technical tool for exercises and training in emergency response decision-making.

3. Basic platform for the emergency response plan system

Based on emergency preparation system theories and methods, researches are encouraged to study the design and construction of the emergency response plan system platform and establish the basic platform for emergency response plan system under the guidance by the Emergence Response Office of the State Council and other state departments. The functions of the basic platform includes the assessment of comprehensive emergency response capability, vulnerability analysis of the emergency preparation system, effectiveness analysis of emergency response, optimization of emergency resource allocation, and modeling of and simulation tools for complex inter-agency disaster response systems. Guidelines and instruction manuals should be compiled to improve the scientific and operational aspect of the emergency response plan system.

IV. Research areas funded in 2009

A total of 301 proposals were received according to the *Guide to Programs of the Major Research Plan for Unconventional Emergency Management* in 2009, including 250 proposals for fostering project, and 51 proposals for key funding projects. After scientific evaluation, 4 proposals for key funding project and 30 proposals for fostering project were funded, respectively. The funded projects cover a broad range of scientific

interdisciplinary fields, mainly involving in areas of network and public opinion, information processing, risk communication, coordination mechanisms, emergency decision-making, resource scheduling, emergency preparedness, evacuation behavior, group psychology and so on. For more detailed information, please refer to NSFC's website: http://www.nsfc.gov.cn/nsfc/cen/00/kxb/gl/manage.html.

V. Priority research areas in 2010

The Major Research Plan will provide three categories of projects, namely, fostering project, key funding project and integrated project. The three project categories differ in funding intensity and research goals. Fostering projects fund those proposals with innovative academic ideas that display sound research value but require further exploration, and encourage interdisciplinary research. Key funding projects mainly support proposals that both exhibit innovative academic ideas and research value and enjoy a sound research basis and experiences, thus are able to make contributions to the overall scientific targets of the Plan. For key funding projects, funding will be given to interdisciplinary research. Integrated projects give funding to proposals with request of much higher funding intensity that may play a decisive role in fulfilling the overall objective of the Plan in the research area concerned. For integrated projects, only interdisciplinary research proposals are accepted.

20-25 fostering projects to be funded in 2010

1. Unconventional emergency information processing and the evolution modeling

(1) New theory for the early collection and analysis of premonitory information;
(2) Methods for social emergency data collection and information monitoring;
(3) Unconventional emergency non-complete information modeling theory and methods;
(4) New methods for quick analysis of real-time dynamic information and compensation for missing data;
(5) Secondary and derivative unconventional emergencies and the nonlinear kinetics of related coupling and variation;
(6) Data and model driven correlation model of unconventional emergencies.

2. Unconventional emergency decision-making theory

(1) Self-adaptive emergency system design theory and methods;
(2) Theory of the comprehensive judgment of unconventional emergencies;
(3) Scenario-oriented emergency decision-making methods in the emergency response process;
(4) Theory and methods for the assessment of the effectiveness of emergency response system;

(5) Conflicting multi-objective multi-phase complex dynamic emergency response decision-making model;
(6) Assessment of hazard effects of unconventional emergencies;
(7) Research on dynamic decision-making in response to disaster-causing unconventional emergencies;
(8) Unconventional emergency response decision-making simulation theory and related modeling and simulation technology systems;
(9) Design of emergency response decision-making information systems and heterogeneous public data base system;
(10) Supervision mechanisms for coordinated supply, expropriation compensation and the use of social relief supplies.

3. Individual and group psychological and behavior response under emergencies

(1) Formation, evolution and intervention of individual attitude toward unconventional emergencies and their disposition;
(2) Patterns of large-scale population mobility and its impact on unconventional emergencies;
(3) Impacts of unconventional emergencies on public mental health and related coping strategies;
(4) Features and mechanisms of dynamic emotional response to emergency;
(5) Behavior features of different social groups in response to emergencies;
(6) Decision-making strategy of leadership teams under emergencies;
(7) Mechanisms and strategies large-scale regional human evacuation under unconventional emergencies.

7 key funding projects to be funded in 2010

1. Unconventional emergency data analysis and scenario-construction theory and methods

Priority topics: scenario required unconventional emergency expression elements, construction methods and inversion models, expression element oriented data collection and analysis mechanisms, multi-source information fusion and dissemination mechanism, and automatic judgment and association principles of real-time information sources in the process of emergencies.

2. Dynamic evolution of unconventional emergency scenario expression elements, prediction theory and models

Priority topics: dynamic scenario requirement of "scenario-response" type of unconventional emergencies, the identification, assessment and mechanism of factors affecting the unconventional emergency process, and scenario and evolution based event reconstruction methods and prediction models.

3. Models and methods for the whole-course dynamic assessment of unconventional emergency disposals

Priority topics: rapid disaster assessment methods for the pre-disposal of unconventional emergency, the sharing, exchange and integration of information and the situation assessment model based on distributed multi-level inter-agency information during unconventional emergency disposals, emergency response plan and effect assessment methods based on real-time information, data mining, simulation prediction and scenario representation.

4. Integrated modeling principles and methods for the analysis of and response to the evolution of unconventional emergencies

Priority topics: network topology and scenario-response model related to unconventional emergency evolution, optimization and the work flow model of the multi-sector collaborative response decision-making and implementation process in response to unconventional emergencies, integrated management mechanism information, knowledge and model of unconventional emergency response decision support, emergency response process oriented information, knowledge and model support, and related integrated theories and methods.

5. Principles and methods for systemized integration of unconventional emergency response technology

Priority topics: emergency response platform system oriented systemized integration principles of unconventional emergency disposal patterns, information access, comprehensive judgment, coordinated response, related methods for system simulation, system optimization, process testing, effect assessment, etc.

6. Social psychology of group behavior and management interventions under unconventional emergencies

Priority topics: psychological impacts of unconventional emergencies on various groups, characteristics personnel behavior and impact factors under unconventional emergencies, personnel behavior improvement model, and psychological education methods and their effects during the process of unconventional emergencies.

7. Psychological reactions of large crowds, emergency evacuation behavior and its intervention mechanism under unconventional emergencies

Priority topics: information communication behavior and its evolution among people during unconventional emergencies, crisis communication's psychological effects on people and related mechanisms, emergency evacuation behavior models and dispersal

methods, organization strategy for crowd dispersal and transportation, and mechanisms of monitoring, prediction and intervention of crowd behavior.

One integrated project to be funded in 2010

Unconventional emergency oriented dynamic simulation system

A distributed, visualized and dynamic simulation system for unconventional emergencies should be established through complex system modeling methods (e.g. social computation, complex networks, etc.), computer simulation and network communication technologies, integrated information modeling theory and methods, and personnel psychological behavior patterns, whole-course unconventional emergency scenario construction and modeling prediction. Academically, the platform could be used as a long-term experimental tool for theoretical studies. Pragmatically, the platform could be used as an auxiliary technical reference tool for unconventional emergency decision-makings.

A total budget of 80 million yuan is planned for the Major Research Plan for Unconventional Emergency Management and is expected to be implemented in a period of 6 years, with the priority areas being defined from 2009 to 2011. A budget of around 28 million yuan is arranged for the fiscal year 2010, based on which, 20-25 fostering projects will be funded with an average funding of 500,000 yuan per project for 3 years, about 7 key funding projects will be funded with an average funding of 1.5 million yuan per project for 3 years, and 1 integrated projects will be funded with an average funding of 9 million yuan per project for 3 years.

VI. Reviewing criteria

(1) Emphasis on unconventional emergency management practices;
(2) Interdisciplinary research among management, information and psychological disciplines;
(3) Focusing on China's status quo and major case studies;
(4) Innovative research ideas centering on the core scientific issues under this Major Research Plan;
(5) Contribution to the overall targets of the Plan and the understanding of core scientific issues;
(6) Academic background, sound research basis and experiences, and potential breakthroughs.

Integrated Research on the Eco-Hydrological Process of Heihe Basin

As one of the most important research areas of the earth system, terrestrial surface system research is emphasized by all branches of earth sciences. This Major Research Plan chooses the Heihe river basin as a typical example of the arid inland watersheds in China to explore the interactions among ecological, hydrological and economic processes in a watershed context. Through the implementation of the Plan, a research platform for observation and experiment, data collection and modeling simulation of both physical and socio-economic processes in the Heihe basin will be established. The Plan aims at revealing the processes and mechanism of the interactions between ecosystem and hydrological system in arid inland watershed and improving the research abilities on analysis and prediction about the inland watershed's hydrological, ecological and economic system evolution, as well as providing the fundamental theories and technical support for water security, ecological security and sustainable development of the economy in inland watersheds.

The Major Research Plan focuses on the following 5 key scientific issues which are significant for achieving the above-mentioned general objectives:

(1) Plant water use efficiency in arid environment and its adaptive mechanism to water stress. This is crucial to understanding the unique form of water use pattern the plant formed in long-term adaptation to arid climates, investigating the characteristics of the hydrological cycle at different spatial scales, and assaying the water use processes of plant individual, population, community, ecosystem and the plant's adaptive mechanism to water stress.

(2) Mechanism of interactions between surface water and groundwater and its eco-hydrological effects. This is crucial to understanding the circulation nature, exchange processes and water quality evolvement of surface water and groundwater, and the major characteristics of the hydrology, water resources and water environment in arid zones and their impact on regional ecological processes.

(3) Mechanism of eco-hydrological processes at different scales and scale conversion methodologies. This is crucial to understanding the interactions between hydrology and vegetation spatial patterns in arid inland watersheds, investigating the interaction mechanism of eco-hydrological processes at different scales, and developing and improving the scale conversion technologies and methodologies.

(4) Response mechanism of watershed eco-hydrological processes to climate change and human activities. This is crucial to understanding the historical evolution of human activities, spatial mode of action and intensity, developing the methodology of converting human factors into spatial parameters, and establishing the watershed ecology, hydrology

and economy coupled models.

(5) Methodological and technological synthesis of experimental observation and data simulation. This is crucial to formulating the research platform that integrates observation, experiment, data simulation at basin scale, improving field observation and research network based on the overall concept of watershed, and establishing the scientific issue oriented research platform that takes watershed as a unique system and aims at the simulation of eco-hydrological processes.

I. Scientific targets

Through the establishment of the "integrated and water-centered eco-hydrological research platform" which links the research components like observation, experiment, simulation, scenario analysis and decision support, the Plan aims to reveal the interaction nature of eco-hydrological processes at the scales of plant individual, community, ecosystem, landscape and watershed, to determine the response mechanism of eco-hydrological processes to climate change and human activities in inland watersheds, to develop the conversion methodologies of different eco-hydrological scales, to establish the watershed ecology, hydrology and social economy coupled models, to improve the understanding for water resources' formation and transformation mechanism in inland watersheds and also to improve the regulatory ability of sustainability.

II. Overall arrangement of the Plan

This Major Research Plan chooses the Heihe River basin as the research area, and deploys research projects according to the above-mentioned overall objectives of the Plan. The duration of the Plan is 8 years with a total budget of 150 million yuan. Applications will be accepted during the first 5 years. Fostering projects and key funding projects will be funded this year, but the integrated projects will not be funded at present.

1. Fostering project (3-year period study)

The funding is targeted at those proposals of basic research with innovative academic ideas on the advanced ecological, hydrological and human dimension issues specific to the Heihe basin.

2. Key funding project (4-year period study)

(1) The funding is targeted at those proposals with significant innovative academic ideas about the basin's ecological, hydrological and economical processes and their interactions and those teams with significant research achievements or research conditions in the basin. These researches are expected to achieve important breakthroughs;

(2) The aerial remote sensing proposals on data collection and environmental parameter

study that can support the integrated eco-hydrological study in the Heihe basin;
(3) Researches on the design and development of the integrated models, data assimilation of watershed land surface and spatial decision support systems for watershed resource management.

III. Funding principles

Proposals for the Plan should meet the following requirements:
(1) Basic research with innovative ideas focusing on eco-hydrological and related issues in the Heihe basin;
(2) Intensification of characteristics of interdisciplinary and systematic projects, focusing on the overall objectives of the Major Research Plan;
(3) Concrete international cooperation is encouraged.

IV. Key funding research areas in 2010

1. Evolution of snow and permafrost and the changing processes of hydrology and water resources

Snow and permafrost are important water sources in inland watersheds. Understanding of the evolution of snow and permafrost and the changing processes of hydrology and water resources has great significance to the researches of the water cycle and water resources formation. Researches should be based on location observation for analyzing the spatial evolution characteristics and their scale effect of snow and permafrost, and developing the physical processes oriented hydrological models with the features of prototype. The following scientific issues should be focused on:
(1) Physical processes of mountain glaciers and snow thawing, and permafrost changes;
(2) Temporal and spatial distribution characteristics, spatial parameters and dynamic simulation of the mountain glaciers, snow cover and permafrost's hydro-thermal process in mountain areas;
(3) Spatial and temporal changes of snow and permafrost' distribution, and the impacts of human activities and climate change on water resources;
(4) Hydrological model development based on the physical processes of glacier, snow and permafrost.

2. Conversion processes of surface water and groundwater and their ecological effects

The conversion between surface water and groundwater in inland watersheds has always been the important content of hydrology researches in arid regions, which provides quantitative identification of the conversion nature between different water forms and their changes under the influence of human activities, and answers to the scientific questions of water potential and the amount of available ground water in arid regions, as

well as the basic foundation for water deployment and management, and watershed's ecological environment development. The following scientific issues should be focused on:

(1) Water movement and conversion nature of hydro-geological units in different vertical and horizontal directions;

(2) Conversion mechanism of groundwater and surface water in dual mode and its ecological effects;

(3) Conversion process and coupled model among atmospheric precipitation, surface water and ground water;

(4) Spatial and temporal distribution and trend prediction of surface water and groundwater's quantity and quality under different water scenarios.

3. Biological mechanism of vegetation water use and water consumption at different scales

Unique adaptive mechanisms to arid climates in terms of water use have been formed for plants in arid areas during their long-term evolution. The revelation of these biological mechanisms in terms of water use efficiency and water consumption could be provided as the important basis for improving water use efficiency in arid areas. The following scientific issues should be focused on:

(1) Water metabolism and its biological regulatory mechanism of plant individuals;

(2) Water use efficiency of individuals, populations, communities, ecosystems and their group effect;

(3) Evaporation characteristics and water consumption mechanism of vegetation at different scale;

(4) Mechanism and threshold of plant adaptation to drought, salinity and wind-sand environment;

(5) Underground biological processes and plant symbiotic mechanism and water responses of desert plants;

(6) Impact of oasis crops on coupled transport of soil water, heat, salt and nutrient, and the formation mechanism of productivity.

4. Interaction mechanism of typical vegetation patterns' eco-hydrological processes

Patchy vegetation pattern is the typical natural vegetation pattern in inland watersheds and the long-term results of adaptation to climate, soil and topography, which has the unique eco-hydrological action mode and specific eco-hydrological functions. Artificial oasis ecosystem, which is strongly influenced by human activities, is the main source of primary production in arid zones. Investigation of the typical vegetation's eco-hydrological processes and their evolution nature of spatial patterns, and clarification of the processes of water cycle, water balance and its regulation mechanism in artificial oasis can directly guide the ecological environment development and ecosystem

management. The following scientific issues should be focused on:

(1) Coupling method for the analysis of natural and human factors' effect on eco-hydrological processes;

(2) Landscape pattern and eco-hydrological processes and their impacts in small watersheds;

(3) Structure, water cycle and water balance of artificial oasis;

(4) Eco-hydrological processes and water demand of desert riparian forest;

(5) Eco-hydrological processes in mountain, desert and oasis areas and their interactions.

5. Evolution of the coupled watershed system of economy, ecology and hydrology

Driven by both climate change and human activities, the linkage effects of hydrological and ecological changes at watershed scale and the socio-economic system have been increasingly obvious. In order to formulate watershed water resources management strategies, it is crucial to understand the impacts of both climate change and human activities on watershed water-ecology-economy system evolution. The following scientific issues should be focused on:

(1) Evolution of the spatial pattern of soil and water resources development and utilization during the past 2000 years;

(2) Driven mechanism of climate change and human activities on watershed eco-hydrological systems;

(3) Evaluation and trend projection of the impacts of major hydraulic and ecological projects on watershed water-ecology-economy system.

6. Integrated model and decision support system of watershed eco-hydrology

Integrated models with modular structures should be established based on a deeper understanding of the mechanisms of hydrological, ecological and socio-economic processes in watershed system. Focusing on water and ecological issues at watershed scale, researches should focus on the investigation of the mechanism of interactions among their natural processes, the realization of the precise expression of these interactions, the improvement of simulation ability of the models, and the provision of decision support for watershed management. The following scientific issues should be focused on:

(1) Methodologies and technologies for scale conversion of watershed eco-hydrological processes;

(2) Integrated models for the watershed system with water, soil, atmosphere, biosphere and human society as its major components (Key breakthroughs are assumed from the coupling of surface water and groundwater, ecological and hydrological, natural and socio-economic processes.);

(3) Spatial decision support system for watershed water resources management;

(4) Assimilation system for high resolution land surface and hydrological data at watershed scale.

7. Processing and publication of the existing ecological and hydrological data in the Heihe basin

Systematized processing and analysis are provided for the existing ground field observation data, aerial remote sensing data and satellite remote sensing data in the Heihe River basin, which assimilate the data sets that serve for eco-hydrological process researches, and analyze the supportive effect and limitations of the existing data for the Major Research Plan.

8. Transect survey

Representative transects and spatial grids should be confirmed in the upstream, midstream and downstream Heihe river basin. Systematized investigation of the vegetation, soil, hydrology, topography and climate characteristics and socio-economic characteristics of human activities should be provided, and corresponding databases be established.

V. Funding and projects in 2010

The funding in 2010 is about 40 million yuan. About 15 fostering projects will be funded with a budget of 0.5-0.6 million yuan per project for 3 years. About 10-12 key funding projects will be funded with a budget 2-3 million yuan per project for 4 years.