



Overview of Chemical Engineering Research in China

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Research Organizations

- Universities
 - ~150/2535
 - ECUST, Tianjin Univ. Tsinghua Univ., Zhejiang Univ. BUCT, Dalian Univ. Tech., China Univ. Petro., Nanjing Univ. Tech., ...
- Chinese Academy of Sciences
 - ~10/114
 - Institute of Chemical Physics, Dalian
 - Institute of Process Engineering, Beijing
 - Institute of Coal Chemistry, Taiyuan
 - Institute of Energy Conversion, Guangzhou
 - Industrial of Biotechnology, Tianjin
 - Institute of Bioenergy and Bioprocess, Tsingtao
 - Shanghai Advanced Research Institute



Key Labs

- State-key labs and national key labs, in universities and CAS
 - 25/(255+7)
 - State Key of Chemical engineering, Fine Chem. Eng., Multiphase Complex System, Efficient Resource Utilization, Materials Engineering, Heave Oil Processing

Basic research+++ , applied research++ , and technological development

- State key labs of enterprise, in companies
 - ~5/177
 - Polyolefin Catalysis and Materials, Shanghai
 - Petrochemical Catalysis and Reaction Engineering, Beijing
 - Green Chemical Technology and Catalyst, Shanghai
 - Membrane Materials and Applications, Tianjin
 - Coal Liquefaction and Coal Chemical Engineering, Shandong
 - Biomass Thermal and Chemical Technologies for Biomass, Hubei

Basic research+ , applied research++ , and technological development ++



Institute of Companies

- Sinopec
 - RIPP, Beijing
 - SRIPT, Shanghai
 - BRICI, Beijing
 - FRIPP, Fushun

- Petrochina
 - Petrochemical Research Institute, with 13 centers and labs

Basic research, applied research⁺⁺, and technological development ⁺⁺⁺

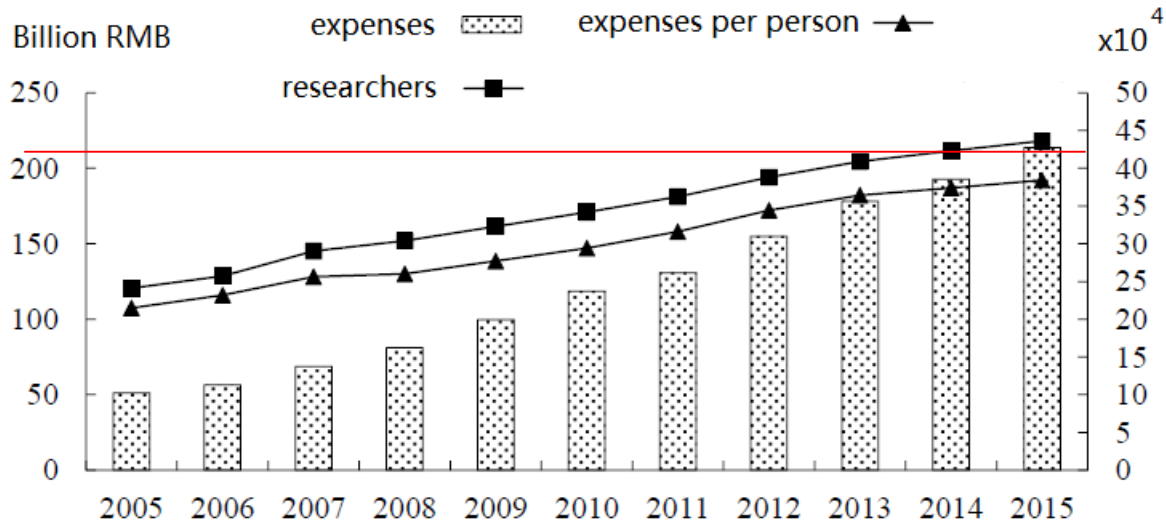


Main Funding Sources by Government

- **Ministry of Science and Technology (MOST)**
- **National Nature Science Foundation of China (NSFC)**
- Ministry of Education (MOE)
- Science and Technology Commission of local government

Government Funding

213.6



R&D Expenses and researchers in government owned research organizations

- Basic research, 13.8%
- Applied research, 28.9%
- Industrial experiment, 57.2%

Expenses for R&D by companies: 1088 billion RMB



National Programs and Projects, 2011-2015

by MOST

- National Mega Project
- National Basic Research Program of China (973 Program)
- National Major Science Research Plan
 - in research fields of protein , quantum control, nano, human development and reproduction, global change, stem cell
- National High-Tech R&D Program (863 Program)
- National Key Technologies R&D program
- Policy Oriented S&T Programs and Special Projects
 - Spark program, Torch program, People benefits program, New products program, Soft science research program
- International Collaboration Program
- Creative Scientists Boosting Program
- Others
 - Agricultural Technology Transfer Fund, Database Building Fund, Key Instrument Development Program, National (or State Key) Lab Program



National Programs and Projects, 2011-2015

by NSFC

- **General Program**
- **Young Scientists Fund**
- **Key Program**
- **Major Research Plan**

- Fund for Less Developed Regions
- Excellent Young Scientists Fund
- National Science Fund for Distinguished Young Scholars
- Science Fund for Creative Research Groups
- **Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao**
- **International (Regional) Cooperation and Exchange Programs**
- **Programs of Joint Funds**
 - Partially from local government, administration, association, or company (Sinopec, PetroChina)
- Tianyuan Fund for Mathematics
- Special Fund for Research on National Major Research Instruments



National Programs and Projects, 2016-2020

New R&D Supporting system

Nature Science Foundation of China

National Mega Project

National key research and development program

--- merging 973, 863, Major Science Research Plan, Key Technologies R&D program

Policy oriented programs

National or State-Key Lab Program

Base and Talent Program

Leading young scientist program

Innovative team program

Technology innovation and application program

Talents development center program



- Divisions
 - Mathematics and physics, **Chemistry**, Life science, Geoscience, **Engineering and Materials Science**, **Informatics**, Management, **Medicine**
- From 7 fields of chemistry
 - Inorganic Chemistry, Organic Chemistry, Macromolecule Chemistry, Physical Chemistry, Analytic Chemistry, Environmental Chemistry, and Chemical Engineering
- To 8 directories
 - Synthetic, catalysis and surface/interface, theory and mechanics, chemometrics, materials and energies, environmental, chemicobiology, chem. eng. & ind. chem.



Budget of NSFC Programs

- General Program, 4 yrs, 60 w
- Young Scientists Fund, 3 yrs , 20 w
- Key Program, 5 yrs , 290 w
- Major Research Plan, 8 yrs
 - Key program, 5 yrs, 300 w
 - Exploratory program, 3 yrs, 80 w
- **Joint Research Fund for Overseas Chinese Scholars and Scholars in Hong Kong and Macao**
 - 2+4 yrs, 18w
- **International (Regional) Cooperation and Exchange Programs**
 - 3 yrs, 200-300 w (from China)
- **Programs of Joint Funds**
 - Key project (4 yrs, ~300 w)), General Project (3 yrs, ~80 w)
- Special Fund for Research on National Major Research Instruments
 - 5 yrs, 1000 w



NSFC-General Program, 2016

Directories	No. of grants	Average budgets, RMB (w)	Success ratio
Chemistry division	1576	64.14	25.99%
Inorganic chemistry	205	64.27	27.30%
Organic chemistry	268	64.09	26.77%
Physical chemistry	302	64.09	26.65%
Macromolecule chemistry	130	64.10	26.97%
Analytical chemistry	181	64.09	26.70%
Chem. Eng. and Ind. Chem.	306	64.09	22.68%
Environmental Chemistry	184	64.28	27.42%



NSFC-Young Scientist Program, 2016

Directories	No. of grants	Average budgets, RMB (w)	Success ratio
Chemistry division	1450	20.2	22.33%
Inorganic chemistry	213	20.2	22.47%
Organic chemistry	280	20.2	22.48%
Physical chemistry	95	20.2	22.88%
Macromolecule chemistry	164	20.2	22.83%
Analytical chemistry	181	20.2	22.63%
Chem. Eng. and Ind. Chem	262	20.2	20.80%
Environmental Chemistry	178	20.2	23.02%



NSFC-Key Program, 2016

Directories	No. of grants	Average budgets, RMB (w)	Success ratio
Chemistry division	61	291	24.71
comprehensive	6	291	37.56
Inorganic chemistry	6	291	23.14
Organic chemistry	9	291	33.00
Physical chemistry	11	291	23.67
Macromolecule chemistry	7	291	34.56
Analytical chemistry	8	291	23.29
Chem. Eng. and Ind. Chem.	9	291	19.40
Environmental Chemistry	5	291	16.53



NSFC-Major Research Plan

- Major Research Plan, 8 yrs, ~100 million RMB
 - Key program, 5 yrs, 300 w
 - Exploratory program, 3 yrs, 80 w
- Controlled Assembly and Functionalization, 2011-
- Mechanism and Manipulation on Mesoscale for Multiphase Reactions, 2013-
- Catalysis Science for Carbon-Based Energy Conversion, 2015-
- Toxicology and Epidemiology Effects of Fine Particulate Matter in Air, 2015-



NSFC-Major Research Plan

Catalysis Science for Carbon-Based Energy Conversion

- Launched in 2015
- Coordinated by Prof. Xinhe Bao, DICP, CAS

Grants	2015	2016	Budget
Key projects	5	4	300 – 400 w
Exploratory projects	36	26	~80 w
Strategy projects		1	1



NSFC-Major Research Plan

Mechanism and Manipulation on Mesoscale for Multiphase Reactions

- Launched in 2013
- Coordinated by Prof. Jinghai Li, IPE, CAS

Grants	2013	2014	2015	2016	Budget
Key projects	6	6	6	4	300 w
Exploratory projects	18	34	28	20	~80 w



MOST-National Mega Project

- Budget: Tens of Billion RMB each
- Totally 16, from 2006-2020
 - Core electronic devices, high-end general-purpose chips and basic software products
 - Integrated circuit equipment
 - Wideband mobile communication
 - Numerical control machine
 - Oil and gas development
 - Nuclear power
 - Water pollution control
 - Transgenesis
 - New drug discovery
 - Infectious disease control
 - Big airplane
 - High resolution earth observation system
 - Manned space flight and lunar exploration project
 - The Big-Dipper satellite navigation system

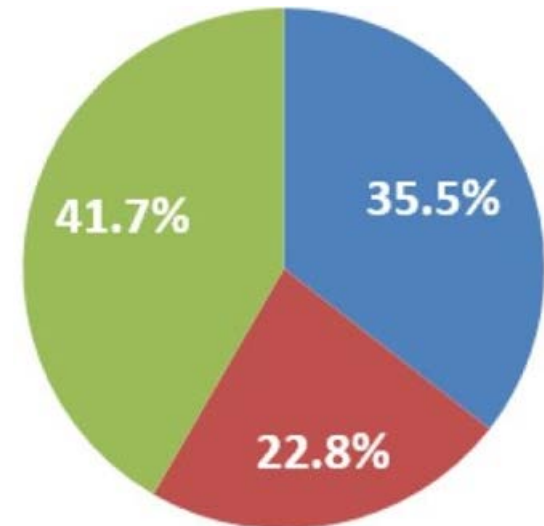
42 Special funds

- Automobile on new energy
- Technology improving and industrialization for key basic materials
- Efficient utilization of coal and new energy saving technologies
- Nanotechnology
- Efficient development and utilization of water resources
- Formation mechanism and control of air pollution

...

- 2016
 - 1172 projects
 - 27.8 billion RMB in total
 - 2525 w/each
- 2017
 - 1078 projects
 - 21.6 billion RMB in total
 - 2010 w/each

■ Universities
■ Companies
■ Institutes





Major Advances in ChE, China

- Coal (slurry or dry powder) gasification, ECUST
- Methanol to olefins, DICP
- Syngas to ethylene glycol, via DMO, ECUST et al
- F-T synthesis, Synfuel
- Direct coal liquefaction, Shenhua

- High-G, for MDI and caprolactam processes, BUCT
- Microreactor, for phosphoric acid exaction, Tsinghua Univ.
- Cyclone technology, for cleaning and recovering, ECUST

- Hollow and single-crystalline TS-1 for PO and cyclohexanone-oxime, RIPP-Sinopec
- Zeolites for aromatic conversion and separation, SRIPT-Sinopec
- Large scale preparation of CNT, Tsinghai Univ.

- Process control and optimization of ethylene plant, ECUST

- Direct, Nonoxidative Conversion of Methane to Ethylene, Aromatics, and Hydrogen, DICP
- Selective conversion of syngas to light olefins, DICP
- Hybrid porous materials for acetylene capture from ethylene, Zhejiang Univ



Challenges for the Future

- Over capacity of most commodity chemicals
- Fine chemicals, functional materials and end-use products more profitable
- Process development mostly in companies such as Sinopec
- More strict environmental constraint
- Cheaper renewable energy (electricity)

- Focus of future research
 - Chemical product engineering: theory and methodology for materials structure manipulation
 - Integrated, smart, distributed, portable, ... device for chemical industry and daily life



Thanks!