Brief History of Carbon in Modern China

- **Production of Carbon materials**
  - **Since 1956**
  - **Graphite electrodes and carbon bricks for metallurgic industry at Jinlin Carbon Corporation**
  - **Carbon brush and mechanical carbons at Harbin Electrical Carbon Plant**
- **Research on Carbon**
  - **Since 1958 at Institute of Metal Research, CAS**
  - **Pyrolytic carbon and graphite**
- **High education specialized in Carbon Science**
  - **Since 1968 at Dept. of Chemical Eng., Hunan Univ.**
  - **Carbon science and technology**

Carbon-related societies

- **Committee of Carbon Materials, Chinese Society for Metals (CCM)**
  - **Originally related to graphite electrodes used in iron & steel industry**
- **Committee of Carbon-Graphite Materials, Chinese Electro-technical Society (CCGM)**
  - **Originally related to carbon brush and carbon materials used in electrical and mechanical industries**

Carbon-related journals

- **Tanso（炭素, Carbon）**
  - **Since 1974 by CCGM, Quarterly**
- **Tanso Jishu（炭素技术, Carbon Techniques）**
  - **Since 1976 by CCM, Bimonthly**
- **Xinxing Tan Cailiao（新型炭材料, New Carbon Materials）**
  - **Since 1984 by Institute of Coal Chemistry, CAS, Quarterly**
  - **Highest scientific level**

Carbon-related symp. & conf.

- **Once a year**
- **Symp. By SCM**
  - **About 100 participants and 50-60 presentations**
- **Symp. By SCGM**
  - **About 90 participants and 60 presentations**
- **National Conference on New Carbons by Editorial Board of New Carbon Materials Journal**
  - **About 200-240 participants and 150 presentations**

Research Fields

- **From industrial production of carbons to carbon nanotubes and C60**
- **Leading research fields:**
  - **Carbon nanotubes**
  - **Carbon/carbon composites**
  - **Activated carbon and carbon fibers**

Research Institutions on Carbon

- **中国科学院金属研究所，沈阳, Shenyang**
  - **Carbon nanotubes VGCFs**
  - **C/C composites and oxidation inhibitors**
  - **Pyrolytic carbon and graphites**
  - **Diamond films and *i*-C films**
- **中国科学院山西煤炭化学研究所，太原, Taiyuan**
  - **Carbon fibers**
  - **Activated carbon and carbon fibers**
  - **C/C composites and oxidation inhibitors**

Research Institutions on Carbon

- 中国科学院物理研究所，北京, Beijing
  - Carbon nanotubes
  - Diamond films
- 湖南大学，长沙, Changsha
  - Carbon negative materials for Li ion battery
  - Industrial carbons
  - Processing for carbon materials

Research Institutions on Carbon

- **北京化工大学，北京, Beijing**
  - **Carbon fibers**
  - **VGCNFs**
  - **Pitch-based carbons**
- **清华大学，北京, Beijing**
  - **Carbon nanotubes**
  - **Intercalation compounds**
  - **Nuclear graphites**

Research Institutions on Carbon

- 西北工业大学，西安, Xi'an
  - C/C composites
- 大连理工大学，大连, Dalian
  - Carbon adsorbents
  - C60 and carbon nanotubes
  - Carbon membranes
- 中南大学，长沙，Changsha
  - C/C composites

Research Institutions on Carbon

- 天津大学，天津，Tianjin
  - Carbon fibers
- 中山大学，广州，Guangzhou
  - Activated carbon fibers
- C60
  - 武汉大学，武汉，Wuhan
  - 北京大学，北京，Beijing
  - 厦门大学，厦门，Xiamen
  - 中国科学技术大学，合肥，Hefei

Brief Introduction of

Institute of Metal Research,

Chinese Academy of Sciences

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Shenyang 110016, China

http://www.imr.ac.cn


RUSSIA
KAZAKHSTAN
UZBEKISTAN
TAJIKISTAN
KYRGYZSTAN
MONGOLIA
GOBI
NORTH KOREA
SOUTH KOREA
Harbin
Changchun
Shenyang
Anshan
Dalian
BEIJING
Tientsin
Qingdao
Ürümqi
TIEN SHAN
Kashi
Taiyuan
Jinan
Yumen
Huang He
Shache
CHINA
Zhengzhou
Nanjing
Lanzhou
KUNLUN MTS.
Xi'an
Hefei
Shanghai
Wuhan
Yangtze
TIBET
Chengdu
Changsha
Fuzhou
PAKISTAN
Lhasa
Chongqing
HIMALAYAS
AFGHANISTAN
Xi Jiang
Guangzhou
TAIWAN
Kunming
BHUTAN
INDIA
NEPAL
Nanning
South China Sea
BANGLADESH
BURMA
VIETNAM
HONG KONG
THAILAND
LAOS
Hainan I.
East China Sea

IMR CAS

Positions of IMRCAS in China

- One of the best research institutions in China
- One of the best research institutions at CAS
- No. 1 for funded research projects from Materials Science Division of NSFC
- Well-recognized research institute on materials science and engineering

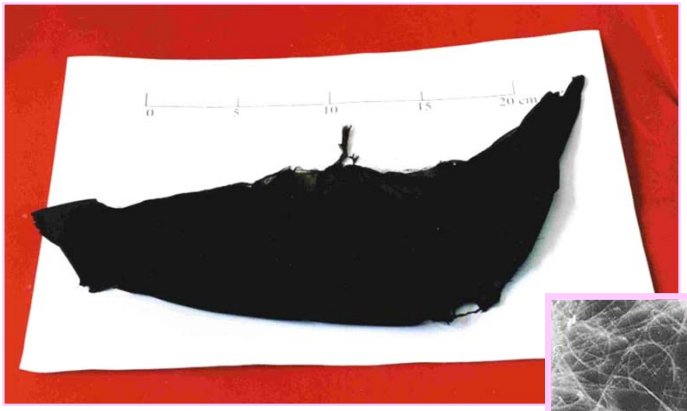
Main Research Fields

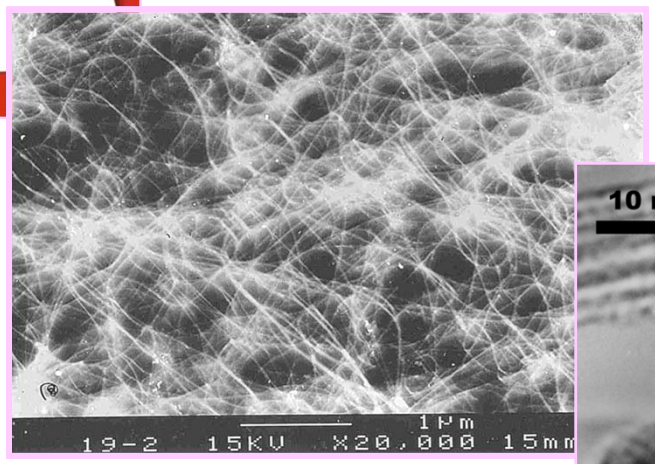
1. Fundamentals of materials science
2. Advanced metallic materials
3. Advanced carbon and ceramic materials
4. Composite materials
5. Synthesis and processing
6. Corrosion science and corrosion control
7. Evaluation and characterization of materials

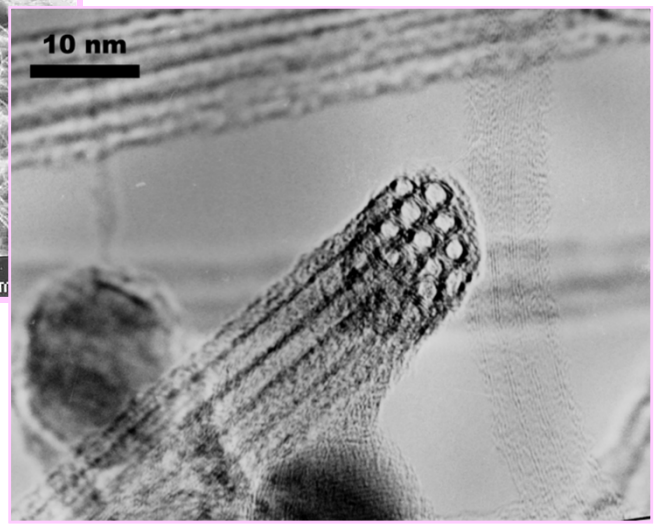
Key Projects of Basic Research

- Special Fund for State Key Basic Research Projects:
  - Super Steel
  - Nanomaterials and Nanostructures
  - Envirionmental Behavior (Chief Scientist)
  - Computational Materials Science (Chief Scientist)
  - Hydrogen Storage and Fuel Cell (Chief Scientist)
  - Novel Processes for Materials
- Major Projects of Nat. Natural Science Foundation:
  - Intermetallics (1998-2001)
  - Special solidification (1999-2002)
  - Natural environmental corrosion (1998-2002)

Large scale sysnthesis of single-walled carbon nanotubes







H_2 storage capacity of SWNTs

Sample	Mass (g)	Pressure (MPa）	Mass Capacity （%）
SWNTs	0.4927	10.0	4.2
$LaNi_5$	1.7628	10.8	1.4

Science, 286 (1999) 1127-1129.

Superplastic extension of nanocrystallized copper at RT

As-deposited

50 mm

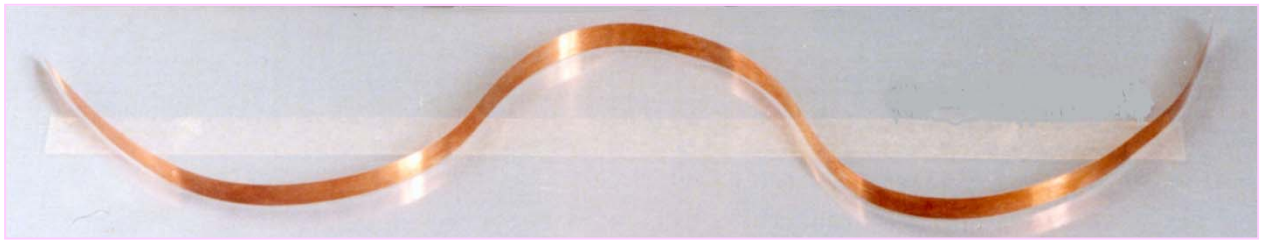
L. Lu et al, Science (2000)

ε=200%

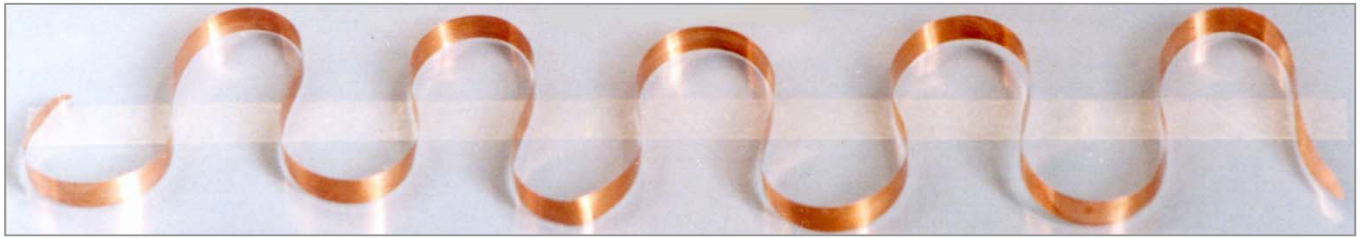
Strain rate $10^{-3}s^{-1}$

$\sim 0.22T_m$

ε=600%



ε=2000%



ε=5100%

Advanced Materials

- **High temperature alloys: superalloys, Ti alloys**
- **Intermetallics: Ni3Al; NiAl; Ti3Al; TiAl; Fe3Al**
- **Metal Matrix Composites:Cf/Al; SiCp,f/Al; Al2O3/Al; SiC/Ti; C/C;C/SiC(chemical vapor infiltration)**
- **Ceramics: SiCw;Si3N4w; Nano-ceramics; Ti_3SiC_2 ceramics**
- **Nano-structured materials (metallic, ceramic, bulk, thin films and particles)**
- **Advanced carbons (CNTs, C/C)**
- **New magnetic materials**
- **Diamond films and functional thin films**

Synthesizing and Processing Techniques

- Microwave sintering and microwave-induced catalysis
- Laser processing
- Precision casting
- Precision tube forming
- Joining of ceramics and metals
- Corrosion and wear protection of materials

Graduate Education

- More than 230 Ph. D students in study
- 120 Master students in study
- An important base for training highly educated scientists on materials science and engineering in China
  - 17 1st class awards from the president of CAS (about 1/10 of the total)
  - 4 Excellent Dissertations from the State (total 200 nationwide for all disciplines, 39 for the whole CAS)

International Scientific Exchange and Cooperation

- Joint research and cooperation between the Institute and foreign universities, research institutes and companies.
- Active scientific visiting and exchange.
- A variety of international scientific conferences and bilateral symposia or workshops on materials science.
- Co-supervision system for graduates.

Synthesis and Property Characterization of Carbon Nanotubes

H. M. Cheng (成会明）

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- Y. Y. Fan
- F. Li
- Q. H. Yang
- P. X. Hou

Main Research Activities of Research Group for Advanced Carbons, IMR CAS

- Synthesis of Carbon Nanotubes and Nanofibers
  - Catalytic decomposition of hydrocarbons
  - Hydrogen plasma electric arc
- Microstructure and Pore Distribution of CNTs
- Properties and Applications of SWNTs, MWNTs and Carbon Nanofibers
  - Mechanical
  - Electric and field-emitting
  - Gas Storage (hydrogen and methane storage)
  - Catalytic
- Synthesis of BN Nanotubes
- Fabrication of Carbon-based Composites

Members of Research Group for Advanced Carbons (in March 2001)

- Group leader: Professor H. M. Cheng
- 1 Associate professor (part time)
- 3 research associates
- 2 technicians
- 1 visiting scientist

- 2 post-docs
- 9 graduates for Ph. D degree
- 4 graduates for Master degree