1. National organizations of cold forging in China and their activities

**Precision Forging Committee of CSTP**
The Precision Forging Committee of China Society for Technology of Plasticity (CSTP) is the national academic organization in the field of precision forging.
The 6th National Symposium on Precision Forging has been held during July 17-19, 2016 in Taizhou, Jiangsu by the Precision Forging Committee of CSTP and co-organized by Jiangsu Pacific Precision Forging Co., Ltd (PPF). There are more than 130 participants from 34 universities and companies, and 43 research or technical papers were published including technical review, hot, cold and warm precision forging process, the tooling technology, the microstructure, property and quality control of forging component, and the forging press and automation. During this symposium, the effect of Chinese national strategy "Made in China 2025" on the precision forging was fully studied and the blueprint for future development of precision forging technology in China was discussed.

**CCFG of CCMI**
The Confederation of Chinese Metalforming Industry (CCMI) founded in July 1986, is a national metal forming industry organization in China. The China Cold Forming Group (CCFG) of CCMI plays the role in the promotion of cold forging industry in China. Several activities relating to precision forging have been held such as:
The 16th China Forge (China Forge Fair Conference 2015) was held from September 13-16, 2015 in Shanghai with 35 invited and keynote presentations. The topics include forging equipment, automation, billet cut-off, heating, heat-treatment, etc.
The 7th China Cold, Warm and Hot Precision Conference has been successfully held from May 18-20, 2015 in Xi’an, Shannxi Province, organized by CCMI and co-organized by Shaanxi Fast Auto Drive Refco Group.
Forging Development Strategy Summit was held from June 2-5, 2016 in Dongguan, Guangdong Province. The 12th 5-year plan in precision forging was summarized and the main developing route of precision forging industry in 13th 5-year plan was discussed in details.
The Exhibition of MetalForm China 2016 will be held from September 21-24, 2016 in Beijing, and “Intelligence, Green, Transition & upgrading” will be the main topic.
2. Cold Forging Industry in China

The cold forging technology developed rapidly in China, and the industry expanded accordingly in recent years. Many companies take cold forging or cold sizing as one of its key manufacturing process. Some of the producers are (in alphabetical order): CH-Forging (Taicang), GKN Shanghai, Haiyan 3D Extrusion Molding, Hirschvogel (Pinghu) Automotive Components, Jiangsu Airship, Jiangsu Pacific Precision Forging (PPF), Jiangsu Sunway Precision Forging (SPF), Longcheng Precision Forging, Luoyang Qinhan Cold Forging, Shaanxi Fast Auto Drive Refco Group, Shanghai Aichi Forging, Shanghai Automobile Gear Works (SAFW), Shanghai Dongfu Cold Forging, Shanghai Haiwei Cold Extrusion, Suzhou Forgewang Technology and Trade Co., Ltd, Taicang Jiuxin Precision Tooling, Tianjin Toyota Forging, Zhangjiagang Stone Forge, etc.

3. University / Institute Researches

There are more than 40 universities or research institutes focusing on researches on metal forming in China. Some of them have been involved in precision forging research for years, such as (sort alphabetically): Beijing Research Institute of Mechanical and Electrical Technology (BRIMET), Beijing University of Science and Technology, Chongqing University, Chongqing University of Technology, Harbin Institute of Technology, Hebei Polytechnic University, Hefei University of Technology, Henan University of Science and Technology, Huazhong University of Science and Technology, Institute of Metal Research Chinese Academy of Sciences, Jilin University, Nanchang University, North University of China, Northwestern Polytechnical University, Shandong University, Shanghai Jiao Tong University, Southwest Technology and Engineering Research Institute, Tianjin University of Technology, Wuhan University of Technology, Xi’an Jiao Tong University, Yanshan University, Zhengzhou Research Institute of Mechanical Engineering, etc.

Following are some introduction of some selected universities or research institutes regarding to cold forging technology from published papers or documents.

- The Institute of Forming Technology & Equipment (IFTE) at Shanghai Jiao Tong University (SJTU) has carried out researches in different field of metal forming process. Recently, thermo elastic deformation of three-layer combined die under steady-state temperature field was researched. The steady-state temperature fields of a three-layer combined die with constant, convection, conduction and convection thermal boundary conditions were determined. Taking a three-layer combined die as an example, warm/hot and cold forging processes were studied under different temperature distributions. There was good agreement between the calculated and FEA results, which validated the theoretical derivation.

- Hubei Key Laboratory of Advanced Technology for Automotive Components of Wuhan University of Technology has studied the microstructure and texture evolution in cold rotary forging of spur bevel gears of 20CrMnTi alloy steel. The results indicate that the grain size distribution is non-uniform from the tooth profile to its center. The
cementite particles in the tooth profile are finer and more uniformly distributed than those in the tooth center. After cold rotary forging, the tooth center has a combination of a- and c-fibers, and the c-fibers are more developed than the a-fibers, while most of the components in the tooth profile are assembled along the a-fibers.

- Huazhong University of Science and Technology presented a short review about forging utilizing flow relief hole. To investigate the mechanism of forging process utilizing flow relief hole, two enclosed die forging case of gears with the same material and outer shape but with different center hole were designed. The stress and strain distribution, metal flow field and forming load were obtained through FEM using rigid plastic material model. Based on the calculation method for conventional enclosed die forging load, a formula for calculating forming load utilizing flow relief hole was developed.

- Zhengzhou Research Institute of Mechanical Engineering studied the effect of forming parameter on multi-stage cold forging with 20MnTiB steel. The results showed that the strain rate has little effect on the microstructure and the mechanical property. However, the number of stages and the deformation degree have an appreciable effect on the sample microstructure, of which the pearlite grain is fined and ferrite grain is elongated as fiber.

- School of Mechanical Engineering at Beijing Institute of Petrochemical Technology studied microstructure and corrosion model of MAO coating on nano grained AA2024 pretreated by ultrasonic cold forging technology. The effect of surface nano-structuring of aluminum alloy on the corrosion performance of MAO coating and the corrosion model of MAO coated AA2024 pretreated by ultrasonic cold forging technology was proposed.

- Hunan University of Science and Technology studied the microstructural of cold forged and annealed Mg alloys. Cold forging deformations (3% and 8%) were carried out on extruded AZ31 and AZ61 Mg alloys, and subsequent annealing was performed at 573 K for different durations. The results show that the thick lenticular twinning is mainly formed at initial deformation stage and subsequently transforms into narrow band twinning.

- College of Mechanical Engineering of Yangzhou University studied the low cycle fatigue and strengthening mechanism of cold extruded large diameter internal thread of Q460 steel. The results show that new grains or sub-grains can be formed on the surface of large diameter internal thread due to grain segmentation and grain refinement during cold extrusion. The fibrous structures appear as elongated and streamlined along the normal direction of the tooth surface which leads to residual compressive stress on the extruded surface.

- Zhejiang University of Technology tried to investigate the possibility of applying electric-hydraulic chattering in the cold extrusion process. The effect of the oil pressure was more significant than the vibration frequency for the reduction of the extrusion load. The velocity of material flow during chattering extrusion process was changed cyclically, and the maximum velocity was higher than that achieved from the conventional extrusion process. The material flow at the corner area was improved. The effective stress distribution was altered periodically due to the chattering.
4. Selected Publications


