

## 1.1 History

The decision to found a Kaiser-Wilhelm-Institut für Kohlenforschung (coal research) in Mülheim/Ruhr was taken in 1912 by the Kaiser Wilhelm Society, representatives of the coal industry and the town of Mülheim/Ruhr. In 1913 Franz Fischer (1877-1947), who in 1911 had been appointed professor for electrochemistry at the Technical University in Berlin-Charlottenburg, was chosen as the first Director.

Franz Fischer and his co-workers carried out basic research in a number of areas concerning the formation and chemical composition of coal as well as on its conversion into solid, liquid and gaseous products. The most important contribution culminated in the so-called Fischer-Tropsch process for coal liquefaction. In 1925, Franz Fischer and the group leader Hans Tropsch reported that liquid hydrocarbons (alkanes) can be produced from carbon monoxide and hydrogen in the presence of solid metal catalysts. The mixture of the two gases (synthesis gas) necessary for this new process was prepared by the “gasification” of coal with steam and oxygen at 900°C. In 1925 the “Studien- und Verwertungsgesellschaft mbH” was founded for the purpose of exploiting the patents. By the early 1940s nine industrial plants were operating in Germany producing ca. 600 000 tons of liquid hydrocarbons per year. Today there is a renewed interest in Fischer-Tropsch technology with plants in Sasolburg/South Africa, Malaysia, and Qatar (using natural gas instead of coal). In 1939 Franz Fischer instigated a change in the status of the Institute; it became a foundation of private law with the objective of supporting the scientific investigation of coal for the public benefit.

Following Fischer’s retirement in 1943 Karl Ziegler (1898-1973) was appointed Director of the Institute. After the founding of the Max Planck Society as the successor of the Kaiser Wilhelm Society in 1948, the Institute obtained its present name in 1949. As a consequence of Ziegler’s appointment, the main research efforts shifted to organometallic chemistry. Based upon his earlier experience with the organic compounds of the alkali metals, Ziegler and his co-workers turned their attention to aluminum. In 1949 they reported the multiple addition of ethylene to aluminum alkyls which became known as the “Aufbau” reaction. The product of this oligomerization was a mixture of aluminum alkyls having long, linear alkyl chains attached to the metal; these compounds could be converted into  $\alpha$ -olefins or primary alcohols, the latter being important for the production of biodegradable detergents. An unexpected observation during the systematic investigation of this reaction led to the discovery that transition metals have a dramatic effect on the “Aufbau” reaction; in particular, the addition of

compounds of titanium or zirconium led to the coupling of up to 100 000 ethylene molecules at normal pressure and temperature. The optimized process employed the so-called organometallic “Mischkatalysatoren” consisting of an aluminum alkyl and a transition metal salt. It was patented in 1953 and led to a dramatic development of the industrial production of polyethylene and polypropylene as cheap and versatile polymers. The licensing of the patents enabled the Institute to be operated on an independent financial basis for nearly 40 years. As a result the Institute expanded and a number of new buildings such as the library, the main research laboratory, pilot plant facilities, high pressure workshops and an instrumental analysis building were constructed. Karl Ziegler was awarded the Nobel Prize for Chemistry in 1963 (together with Giulio Natta who analyzed the stereochemistry of polypropylene). Ziegler subsequently created the Ziegler-Fund (in 1968) and the Ziegler-Foundation (in 1970), which still play an important role in financing the Institute.

In recognition of the fundamental importance of Karl Ziegler’s discoveries and their tremendous implications for industry, the German Chemical Society (GDCh) bestowed the title “Historische Stätte der Chemie” (Historical Landmarks of Chemistry) on the Institute in 2008. A bronze plaque on the historic building commemorates this event. On this occasion, a brochure was published, which reviews the Ziegler era in some detail. This information is also available via the Internet at [http://www.mpi-muelheim.mpg.de/kofo/english/institut/geschichte\\_e.html](http://www.mpi-muelheim.mpg.de/kofo/english/institut/geschichte_e.html).

Günther Wilke followed Karl Ziegler as Director in 1969. His research concentrated on the organometallic chemistry of the transition metals (especially nickel) and its application in homogeneous catalysis. The cyclodimerization and the cyclotrimerization of butadiene using homogeneous nickel catalysts were exploited industrially. Ligand-control led to the development of highly selective homogeneous catalysts, including catalysts bearing chiral ligands. The Institute also pursued research in electrochemistry, contributing an efficient electrochemical synthesis of iron(II) ethanolate which became industrially important for the production of ferrocene. Investigations on the use of supercritical gases for purification purposes, which was first described by Kurt Zosel in Mülheim/Ruhr in 1963, led to a large-scale industrial process for the decaffeination of green coffee beans using supercritical carbon dioxide. Roland Köster, a Scientific Member of the Max Planck Society since 1969, headed his own group during these years, which was primarily concerned with organoboron chemistry.

In 1993 Manfred T. Reetz was appointed Director of the Institute. As an organic chemist he initiated projects in his own group pertaining to catalysis, transition metal colloids and directed evolution of enzymes. He also re-defined the scientific activities of the Institute as a whole, a development which resulted in the establishment of five Departments comprising Synthetic Organic Chemistry, Homogeneous Catalysis, Heterogeneous Catalysis, Organometallic Chemistry and Theory. This plan foresaw the appointment of Scientific Members as Directors of these Departments. In 1995 Andreas Pfaltz joined the Institute as the Director of the Department of Homogeneous Catalysis, while Manfred T. Reetz headed the Department of Synthetic Organic Chemistry. Thereafter the appointments of Ferdi Schüth (Heterogeneous Catalysis), Alois Fürstner (Organometallic Chemistry) and Walter Thiel (Theory) followed. Thus, the scientific activities of the Institute were put on a broad and interdisciplinary basis.

Following Andreas Pfaltz' move back to Basel, the position of the Director of the Department of Homogeneous Catalysis remained vacant for some time. Benjamin List from the Scripps Institute, La Jolla, was identified as a pioneer in the then emerging field of organocatalysis. He was hired on a C3-position (associate professor) in 2003, and promoted to become the Director of the Department in 2005.

The Directors of the Departments form a Board which is responsible for all decisions. The affairs of the Institute are taken care of by a Managing Director elected from this Board. As successor to Manfred Reetz, Ferdi Schüth served as Managing Director from 2003-2005, followed by Walter Thiel (2006-2008) and Alois Fürstner (2009-2011).