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触媒技術の動向と展望　創刊 20 周年記念企画別冊英語版「Special Edition for the 20th Anniversary of Publication of "Annual Survey of Catalytic Science and Technologies" by the Catalysis Society of Japan」のご案内

触媒学会では 1993 年度から事業の一環として、「触媒技術の動向と展望」と題した年鑑の出版を行っております。

創刊 20 周年記念号の 2012 年度版では、金属触媒、酸化物触媒、生体・錯体触媒、重合触媒、キャラクタリゼーション、光触媒、石油化学、高分子合成、バイオベース化学の九つの触媒分野における研究開発の歴史と将来展望をまとめた特集を掲載しております。

この特集の英語版ならびに大学・高専・国公立研究機関における研究活動(研究者総覧)の英語版を別冊として製本し、販売いたします。

この別冊は海外の触媒研究者に日本における触媒の研究動向、研究者を紹介する際にもお役立ていただける内容となっています。また、大学院にて触媒研究を行っている院生等にとりましても必読の書となっています。

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Special Edition for the 20th Anniversary of Publication of
"Annual Survey of Catalytic Science and Technologies"
by the Catalysis Society of Japan

1. Contributions to the Special Edition

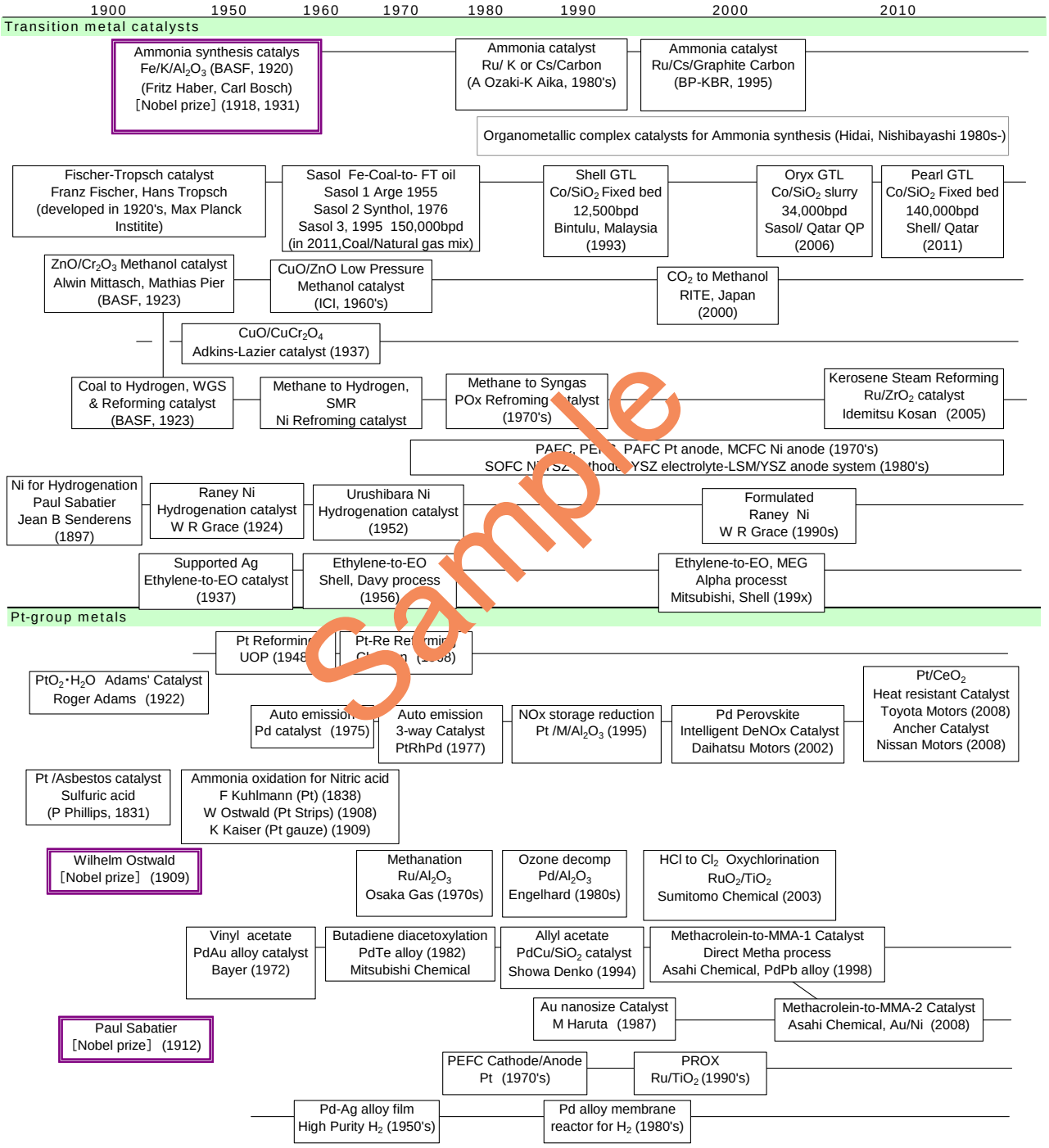
2. Recent activities of Japanese academic organizations

目次に戻る（見本用）

Special Edition of the 20th Anniversary of CATSJ survey

The history and development of metallic catalysts

Takashiro Muroi※



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※ Industrial Catalysts Laboratory, 5-8-5 Kariya, Ushiku, 300-1235 Ibaraki, Japan

1. Introduction

The fundamentals of industrial catalysts used in modern chemical and environmental processes were discovered by the middle of the 20th century. In these first-generation processes, severe reaction conditions were applied, resulting in high construction and utility costs and performance that was inferior to that found in modern chemical plants. The second generation catalysts developed in the latter half of the 20th century were more sophisticated. They not only extended the variety of usable feedstocks and products manufactured, but also reduced the consumption of material and energy inputs, thus achieving higher profitability and lower environmental emissions. These catalysts were developed primarily for continuous and commercial-scale processes, and contributed to the establishment of a modern and prosperous chemical industry. Even in ammonia synthesis, the highest pressure and high temperature process in the chemical industry, Japanese chemists discovered a Ru/Cs-based high-performance catalyst in the 1980s that can function at much lower pressure and temperature. The first commercial use of this Ru/Cs-based catalyst was by BP-KBR in 1996. Further progress and enhanced contributions from catalysts is expected moving forward in order to combat global warming and an anticipated shortage of fossil fuel resources in the near future.[1)]

2. The history of metallic catalysts

2.1 1831-1900 (In the beginning)

Metallic catalysts were already utilized in the nascent stages of the chemical industrial revolution in the 19th century in Europe. An asbestos-supported Pt (P. Phillips, 1831) was the first catalyst that appeared in industry for the commercial production of sulfuric acid, an important material for producing sodium carbonate by the Leblanc process (N. Leblanc, 1791). The chamber process (introduced in 1746), or NO_2-catalysed SO_2 oxidation process, was gradually switched to the new catalytic process. In 1913, F. Slama and H. Wolf patented, a catalyst made of a salt of vanadic acid with alkali promotors on a porous support for this process. The V_2O_5-alkali catalyst became popular soon after this finding, replacing all the Pt-catalysed processes. Nitric acid, another basic material in the chemical industry, was produced by acidolysis of KNO_3 with sulfuric acid when Alfred Nobel developed dynamite in 1866. The concept of vapor phase oxidation of ammonia to nitric acid was proposed by F. Kuhlmann in 1838, but the first industrial process was only developed in the 1920s, when an ample supply of gunpowder was required and the Pt gauze (multiple layers of a fine wire mesh) catalyst was invented. The activity of various finely-dispersed metallic hydrogenation catalysts was studied by Paul Sabatier, who together with Jean B. Senderens in France discovered the Ni catalyst for hydrogenation of unsaturated compounds in 1897. In the same year Joseph Crosfield & Sons succeeded in producing hardened (or hydrogenated) oil via Ni catalyzed hydrogenation of fish and vegetable oils in the UK.

2.2 1900-1960 (Rise of metallic catalysts and coal era)

Many new catalytic processes were developed during the golden era of 1900 to the 1920s. Production of nitric acid was started via catalytic oxidation of ammonia with a coil of Pt strips by Wilhelm Ostwald in 1906, and soon after with a Pt gauze catalyst developed by K Kaiser in 1909. Further, ammonia was produced via the calcium cyanamide process from calcium carbide.