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AN ANNOTATED BIBLIOGRAPHY ON THE EFFECTS OF
RADIATION ON HETEROGENEOUSLY CATALYZED
REACTIONS AND ON CHEMISORPTION

N. A. Krohn

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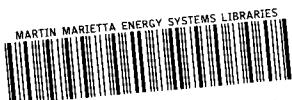
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HETEROGENEOUSLY CATALYZED REACTIONS AND ON CHEMISORPTION

N. A. Krohn

ABSTRACT

This bibliography was compiled primarily from a search of Chemical Abstracts, Nuclear Science Abstracts, and Dissertation Abstracts through December 1962. The annotations give the type of radiation, the catalysts investigated, and the test reactions used. The entries are cross-referenced, and indexes of the authors, catalysts, reactions, and type of radiation are provided. The compilation is limited to papers in which either heterogeneously catalyzed reactions, chemisorption, or the radiolysis of adsorbed substances was studied. Papers on the effects of ultraviolet light are not included.

INTRODUCTION

The number of researchers studying the effects of radiations on heterogeneous catalysis has been growing steadily in recent years. The purpose of this bibliography is to provide a useful guide to work already published.

This bibliography was compiled primarily from a search of the following sources:

- a. Chemical Abstracts through volume 57, 1962
- b. Nuclear Science Abstracts through volume 16, 1962
- c. Dissertation Abstracts through volume 23, No. 6, Dec. 1962
- d. "Selected Abstracts of Atomic Energy Project Unclassified Report Literature in the Field of Radiation Chemistry and Bibliography of the Published Literature," AERE-C/R-1575 and supplements 1-5, compiled by R. W. Clarke.

Additional entries were obtained from Chemical Titles, personal contacts, and tables of contents of journals.

The entries are listed alphabetically by author, except for patents, some project literature, and those numbered 251 to 264, which were added

to the original list. Patents are listed under the name of the issuing country, and some project literature is listed under the name of the issuing institution. Journal abbreviations correspond to those given in Chemical Abstracts 55 (1961).

Each entry is annotated according to the following scheme:

- a. Gives test reaction used
- b. Gives catalysts investigated
- c. Gives type of radiation used
- d. Remarks.

Information given in the entry title is not repeated in the annotations. Unless otherwise specified "gamma radiation" is taken to mean Co⁶⁰ radiation, since this was almost always the source used.

The compilation is limited to papers in which either heterogeneously catalyzed reactions, chemisorption, or the radiolysis of adsorbed substances was studied. Papers on the effects of radiation on solid-gas reactions, corrosion phenomena, decomposition of solids, physical adsorption or electronic properties are not included. Types of radiations include alpha and beta particles, gamma and x rays, neutrons, protons, deuterons, electrons, and argon ions. Ultraviolet light effects are not included.

Indexes of authors, catalysts, radiations, and reactions are given. Review articles are listed in the Reaction Index.

1. Ablyaev, Sh. A., S. E. Ermakov, and S. V. Starodubtsev, Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR 1, 174 (1961). "Change in the Adsorption Properties of Silica Gel under the Effect of Gamma-irradiation."
 - a. Adsorption of H₂, N₂, CO₂, NH₃, and C₂H₄
2. Allen, A. O., "The Radiation Chemistry of Water and Aqueous Solutions" D. Van Nostrand, Princeton, 1961, pp 113-116.
 - d. Brief discussion of heterogeneous systems
3. Allen, A. O., and J. M. Caffrey, Translation of the All-Union Scientific Technical Conference on the Use of Radioactive and Stable Isotopes and Radiations in the National Economy and in Science, Moscow, 1957. Isotopes and Radiation in Chemistry, AEC-tr-4497, p 162. "Radiolysis of Pentane Adsorbed on Solids."
 - d. See reference 45
4. Andersen, H. C., G. Cohn, C. D. Keith, and P. N. Rylander, "Effect of Irradiation of Solid Catalysts," Final Report, NYO-2836, Sept. 30, 1960.
 - a. Oxidation of hydrogen and carbon monoxide; decomposition of N₂O; naphtha reforming; hydrogenation of benzene, chlorobenzene, propyl nitrile, butyne-diol-1,4, heptaldehyde, nitropropane, butyl chloride
 - b. Pt, Pd, Rh, Ru, Ir, and PdO on various supports (Al₂O₃, SiO₂-Al₂O₃, C, BaCO₃, BaSO₄, CaCO₃, SrCO₃, NiO, ZnO)
 - c. Co⁶⁰, accelerator electrons
5. Andersen, H. C., and P. N. Rylander, "Effect of Irradiation of Solid Catalysts," Quarterly Progress Report No. 1, TID-5983, Aug. 1959.
 - d. See reference 4
6. Andersen, H. C., and P. N. Rylander, "Effect of Irradiation of Solid Catalysts," Quarterly Progress Report No. 2, TID-5984, Nov. 1959.
 - d. See reference 4

7. Andersen, H. C., P. N. Rylander, and C. D. Keith, "Effect of Irradiation of Solid Catalysts," Quarterly Progress Report No. 3, AECU-4733, Feb. 1960.
 - d. See reference 4
8. Baberkin, A. S., N. P. Krushinskaya, and M. A. Proskurnin, Dokl. Akad. Nauk SSSR 132, 1329 (1960). "The Effect of Solids on the Decomposition of CCl_4 in an Aqueous Solution under the Action of Gamma Rays."
 - b. C, SiO_2 gel, Al_2O_3 , Fe_2O_3 , Cu_2O
9. Balandin, A. A. et al., Akad. Nauk SSSR, Otd. Khim. Nauk, Akad. Nauk SSSR i Gos. Optich. Inst. Sb. Statei 4, 565 (1961). "Effects of Radioactive Irradiation on the Catalytic Properties of Solids."
 - d. Reference from BMI-X-10009 (See reference 141)
10. Balandin, A. A., V. I. Spitsyn, L. I. Barsova, and V. I. Duzhenkov, Zh. Fiz. Khim. 33, 736 (1959). "Preparation of a Platinum Catalyst by an Irradiation Method."
 - a. Hydrogenation of cyclohexene
 - b. 1.5-Mev electrons
11. Balandin, A. A., V. I. Spitsyn, N. P. Dobrosel'skaya, and I. E. Mikhailenko, Dokl. Akad. Nauk SSSR 121, 495 (1958). "Radioactive Catalysts - The Dehydration of Cyclohexanol on Magnesium and Sodium Sulfates."
 - c. Incorporated S^{35}
12. Balandin, A. A., V. I. Spitsyn, N. P. Dobrosel'skaya, and I. E. Mikhailenko, Dokl. Akad. Nauk SSSR 137, 628 (1961). "Radioactive Catalysts - The Dehydration of Cyclohexanol over Magnesium Sulfate and Calcium Chloride."
 - c. Incorporated Ca^{45}

13. Balandin, A. A., V. I Spitsyn, N. P. Dobrosel'skaya, I. E. Mikhailenko, I. V. Vereshchinskii, and P. Ya. Glazunov, Actes. Congr. Intern. Catalyse 2^e, Paris, 1960 2, 145 (Pub. 1961). "The Influence of the Radioactive Radiation of a Solid Body on its Catalytic Properties."
 - a. Dehydration of cyclohexanol
 - b. MgSO₄-Na₂SO₄; MgSO₄-CaCl₂
 - c. Incorporated S³⁵ or Ca⁴⁵, 800 kev electrons
14. Balandin, A. A., V. I. Spitsyn, N. P. Dobrosel'skaya, I. E. Mikhailenko, I. V. Vereshchinskii, and P. Ya. Glazunov, Izv. Akad. Nauk SSSR, Otd. Khim. Nauk, 1961, 565. "On the Influence of the Radioactive Radiation of a Solid Body on its Catalytic Properties."
 - d. See reference 13
15. Balandin, A. A., V. I. Spitsyn, V. I. Duzhenkov, and L. I. Barsova, Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR 1, 289 (1961). "Radiation-chemical Method of Production of Metallic Catalysts."
 - a. Hydrogenation of cyclohexene
 - b. Pt, Pd
 - c. See reference 10
16. Ballantine, D. S., and B. Manowitz, Progress Report on Fission Products Utilization VIII. Studies on the Use of Radiation as a Catalyst for Chemical Reactions, BNL-389 May 1956, p 18. "Polymerization of Butadiene on Carbon Black."
 - c. Co⁶⁰
17. Barry, T. I., Actes Congr. Intern. Catalyse 2^e, Paris, 1960 2, 1449 (Pub. 1961). "The Adsorption of Oxygen on Zinc Oxide: The Effect of Gamma Radiation."
18. Barry, T. I., and K. Klier, Discussions Farady Soc. 31, 219 (1961). "Gamma-irradiation of Zinc Oxide and its Effect on Adsorbed Layers."
 - a. Hydrogen, oxygen, and iso-butene adsorption

19. Barry, T. I., and R. Roberts, "Gamma Radiation and Catalysis - The Methanol Synthesis over Zinc Oxide," Harwell Report AERE I/R 2746 (1958).
20. Barry, T. I., and R. Roberts, Nature 184, 1061 (1959). "Effect of Gamma Radiation on the Synthesis of Methanol over Zinc Oxide."
21. Belgian Patent 601,253, Societe Belge d l'Azote et des Produits Chimiques du Marly, S. A. and Centre d'Etude de L'Energii Nucleaire. "Irradiation of Chemical Systems."
 - a. C₂H₄ polymerization; reaction of CCl₄ with C₂H₄; NH₃ synthesis; oxidation of N₂; radiolysis of N₂O, CH₄, and C₂H₄
 - b. Al₂O₃-UO₂; SiO₂; Al₂O₃; activated C; activated C-UO₂; molecular sieve
 - c. Co⁶⁰
22. Belyakova, L. D., V. V. Gromov, A. V. Kiselev, and V. I. Spitsyn, Dokl. Akad. Nauk SSSR 138, 1139 (1961). "The Adsorption of Hexane and Benzene Vapors on Inactive and Radioactive Barium Sulfate."
 - c. Incorporated S³⁵
23. Belyakova, L. D., V. V. Gromov, A. V. Kiselev, and V. I. Spitsyn, Radiokhimiya 4, 410 (1962). "Adsorption of Various Substances on Radioactive Samples of Barium Sulfate."
 - a. Ar, N₂, hexane, benzene, methanol adsorption
 - c. Incorporated S³⁵
24. Bragg, R. H., F. L. Morritz, R. Holtzman, P. Y. Feng, F. Pizzarello, "Effects of Nuclear Radiation on Solid Catalysts," WADC Tech. Report 59-286, May 1959.
 - a. C₂H₄ hydrogenation
 - b. ZnO
 - c. Co⁶⁰, fast neutron, reactor

25. Bragg, R. H., F. L. Morritz, R. Holtzman, P. Y. Feng, and F. Pizzarello, "Effects of Nuclear Radiation on Solid Catalysts," U. S. Dept. Com. Office Tech. Serv. PB Report 161,130 (1959).
 - d. See reference 24
26. Braun, T., and I. Maxim, Nature 192, 548 (1961). "Radiation Effects on Lithium Doped Nickel Oxide Catalysts in Carbon Monoxide Oxidation."
 - c. Reactor
27. British Patent 800,563, Dow Chemical Company, Aug. 27, 1958. "Irradiation of Catalysts used to Dehydrogenate Unsaturated Hydrocarbons."
 - a. Dehydrogenation of n-butene to butadiene
 - b. Calcium-nickel phosphate, 2% chromium oxide
 - c. Co⁶⁰
 - d. See also reference 227
28. British Patent 814,562, Esso Research and Engineering Co., June 10, 1959. "Hydrocarbon Conversion by Slow-Neutron Irradiation."
 - a. Conversion of hexadecane
 - b. SiO₂-Al₂O₃, Pt-Al₂O₃
 - c. Reactor
29. British Patent 823,099, Esso Research and Engineering Co., Nov. 4, 1959. "Manufacture of Lubricants by Irradiation of Hydrocarbons".
 - a. Cetane conversion
 - b. SiO₂-Al₂O₃, Pt-Al₂O₃, metals and metal oxides in general
 - c. Reactor
30. British Patent 823,426, Esso Research and Engineering Co., Nov. 11, 1959. "Hydrocarbon Conversion Process."
 - a. Desulfurizing, polymerizing, dehydrogenating, isomerizing, aromatizing, and cracking of hydrocarbons
 - b. SiO₂-Al₂O₃, Al₂O₃, Pt-Al₂O₃, B₂O₃-SiO₂-Al₂O₃, B₂O₃-Al₂O₃
 - c. Combined gamma and neutron radiation

31. British Patent 894,625, National Research Development Corp., (by E. J. Gibson), April 26, 1962. "Irradiation of Iron Oxide Catalysts."
 - a. Fischer-Tropsch process
 - b. Co^{60} , 16-Mev electrons
32. Brookhaven National Laboratory, Annual Report, July 1, 1958, BNL-523 p 77. "Radiation Catalysis."
 - a. o-p hydrogen conversion
 - b. MoO_3 , $\text{Al}_2\text{O}_3\text{-MoO}_3$, $\gamma\text{-Al}_2\text{O}_3$
 - c. Co^{60}
 - d. See also reference 136, 137
33. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, Jan. 1 - March 31, 1958, BNL-506, p 23. "Radiation Catalysis."
 - d. See reference 32
34. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, April 1 - June 30, 1958, BNL-516, p 25. "Radiation Catalysis."
 - d. See reference 32
35. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, Oct. 1 - Dec. 31, 1958, BNL-554, p 30. "Radiation Catalysis."
 - a. o-p hydrogen conversion
 - b. MgO
 - c. Co^{60}
 - d. See reference 94 for topical report
36. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, Jan. 1 - April 30, 1959, BNL-571, p 32. "Radiation Catalysis."
 - d. See reference 94

37. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, May 1 - Aug. 31, 1959, BNL-583, p 28. "Radiation Catalysis."
 - d. See reference 94
38. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, Sept. 1 - Dec. 31, 1959, BNL-595, p 25. "Radiation Catalysis."
 - a. o-p hydrogen conversion; O₂ and CO adsorption
 - b. MgO
 - c. Co⁶⁰
 - d. See reference 94
39. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, May 1 - Aug. 31, 1960, BNL-646, p 17. "Radiation Processing Program."
 - a. Oxidation of N₂
 - b. Al₂O₃
 - c. Co⁶⁰
40. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, May 1 - Aug. 31, 1961, BNL-696, p 15. "Radiation Process - Formation of Hydrazine and Hydroxylamine."
 - a. Radiolysis of adsorbed NH₃
 - b. Linde 5A molecular sieve
 - c. Co⁶⁰
41. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, Sept. 1 - Dec. 31, 1961, BNL-705, p 18. "Radiation Process - Gamma Irradiations of Aqueous and Anhydrous Ammonia."
 - a. Radiolysis of adsorbed NH₃
 - b. Linde 13X molecular sieve
 - c. Co⁶⁰
 - d. See references 252 and 257

42. Brown, W. G., and H. E. Krizek, "Radiolysis of Methanol Adsorbed in a Synthetic Zeolite-Energy Transfer Effects," WADD Technical Note 60-28, June 1960.
 - b. Linde 5A molecular sieve
 - c. Co⁶⁰
43. Bussiere, P., Chim. Mod. 6, 289 (1961). "Isotopes and Radiation in Catalysis."
 - d. Review
44. Bussiere, P., Ind. At. 5, No. 5/6, 77 (1961). "Isotopes and Radiation in Catalysis."
 - d. Essentially the same as reference 43
45. Caffrey, J. M., and A. O. Allen, J. Phys. Chem. 62, 33 (1958). "Radiolysis of Pentane Adsorbed on Mineral Solids."
 - b. Various silicas, Fe₂O₃, Fe₃O₄, MgO, montmorillonite, attapulgite
 - c. Co⁶⁰
46. Charman, H. B., and R. M. Dell, Phys. Chem. Solids 23, 1567 (1962). "Fast Neutron Damage at the Surface of Metal Oxides."
 - a. Chemisorption of O₂ and H₂
 - b. NiO, MgO
 - c. Reactor
 - d. See reference 253
47. Clark, G. L., Brit. J. Radiol. 23, 112 (1927). "New Experiments on Effects of X-rays in Photochemical Oxidation, Catalyst Activation, and the Ionization of Gaseous Mixtures Containing Detonation Inducers and Suppressors."
 - a. Contact process for H₂SO₄
 - b. Pt

48. Clark, G. L., Colloid Symposium Monograph, Vol. IV, Chemical Catalog Company, New York, 1926, p 145. "X-rays and Colloids."
 - a. SO₂ oxidation
 - b. Pt
 - c. Brief review
49. Clark, G. L., P. G. McGrath, and M. C. Johnson, Proc. Nat. Acad. Sci. U. S., 11, 646 (1925). "The Effect of X-rays on the Platinum Catalyst in the Contact Sulfuric Acid Reaction."
50. Clarke, R. W., and E. J. Gibson, Nature 180, 140 (1957). "Effect of Ionizing Radiation on Solid Catalysts."
 - a. Fischer-Tropsch process
 - b. Co-ThO₂-MgO-kieselguhr, iron oxide (mill-scale)
 - c. Co⁶⁰
 - d. See reference 72
51. Clingman, W. H., Ind. Eng. Chem. 52, 915 (1960). "Photosensitized Oxidation of Propane with X-rays."
 - b. ZnO, ZnO-Al₂O₃
 - c. 200-kv x rays
52. Cochran, A. A., and P. W. Martin, "Effect of Ionizing Radiation on the Chlorination of Mixtures of Rutile, Carbon and Various Catalysts," BM-RI-5994, Oct. 1961.
 - b. MnO₂, CeO₂, ZrO₂, MnCl₂
 - c. 120-kv x rays
53. Coekelbergs, R., A. Crucq, and A. Frennet, Advan. Catalysis 13, Academic Press, New York, 1962, pp 55-136. "Radiation Catalysis."
 - d. Theory and review (primarily of authors own work)

54. Coekelbergs, R., P. Gosselain, J. Juliens, M. Van der Venne, Large Radiation Sources Ind., Proc. Conf. Warsaw 1959 1, 191 (Pub. 1960)
"Use of Microporous Nuclear Fuels as a Means of Utilizing the Kinetic Energy of Fission Products in Chemical Synthesis."
a. N₂O decomposition, CH₄ radiolysis, N₂ fixation
b. UO₂-SiO₂, UO₂-Al₂O₃, UO₂-activated C
c. Reactor
55. Coekelbergs, R., P. Gosselain, and L. J. Schotmans, Proc. U. N. Intern. Conf. Peaceful Uses At. Energy, 2nd, Geneva, 1958 29, 424 (Pub. 1959). "Investigations of a Nuclear Fuel Making it Possible to Use the Kinetic Energy of Fission Products for Chemical Synthesis."
a. N₂O decomposition
b. UO₂ dispersed in Al₂O₃, active C or SiO₂ gel
c. Reactor
56. Cropper, W. H., Science 137, 955 (1962). "Radiation Effects on the Reactivity of Solid Surfaces."
d. Review
57. Czikk, A., J. Dempsey, S. Engel, and W. A. Selke, "Utilization of Waste Fission Products in Chemical Reactions," NYO-3329, April 1, 1953.
a. NH₃ synthesis, SO₂ oxidation
b. glass wool, V₂O₅
c. Co⁶⁰
58. Dalmai, G., B. Imelik, and M. Seguin, J. Chim. Phys. 58, 292 (1961). "Modification of the Catalytic Activity and the Texture of Silica Gels Irradiated in Piles."
a. HCOOH decomposition

59. Davies, H. A., "Relationship of Conductivity and Catalytic Activity of Semiconductors to Excitation by Gamma-radiation" (Univ. of Florida, Gainesville) Univ. Microfilms L. C. Card No. Mic. 60-6664, Dissert. Abstr. 21, 2648 (1961).
 - a. Methanol decomposition
 - b. ZnO
 - c. Co⁶⁰; incorporated Zn⁶⁵
 - d. See reference 213
60. Dienes, G. J., in "Reactivity of Solids," Proc. Intern. Symp. Reactivity Solids, 4th, Amsterdam, 1960, J. H. DeBoer (Ed.) Elsevier, 1961, p 416. "Radiation-induced Defects and the Chemical Reactivity of Solids."
 - d. Review including effects on catalysts
61. Donato, M., Nature 194, 969 (1962). "Radiation Effects on Zinc Oxide Catalyst in Dehydrogenation of Ethyl Alcohol."
 - c. Reactor
62. Donato, M., "Radiation Effects on p- and n- type Catalysts Used in the Thermal Dissociation of Ethyl Alcohol," Paper presented at the 142nd National Meeting of the American Chemical Society, Atlantic City, Sept. 1962.
 - b. ZnO, Cr₂O₃
 - c. Reactor
63. Emmett, P. H., "New Approaches to the Study of Catalysis," 36th Annual Priestly Lectures, Penn. State Univ., April 9-13, 1962, pp 83-88. "The Influence of Radiation on Catalytic Reactions."
 - d. Brief discussion
64. Emmett, P. H., and E. J. Jones, J. Phys. Chem. 34, 1102 (1930). "The Effect of X-radiation on a Platinum Catalyst in the Synthesis of Water."

65. Emmett, P. H., R. Livingston, H. Zeldes, and R. J. Kokes, *J. Phys. Chem.* 66, 921 (1962). "Formation of Hydrogen Atoms in Irradiated Catalysts."
 - a. Decomposition of water and OH groups
 - b. SiO_2 , Al_2O_3 , $\text{SiO}_2\text{-Al}_2\text{O}_3$
 - c. Co^{60}
66. Farnsworth, H. E., and R. F. Woodcock, *Advan. Catalysis* 9, 123 (1957). "Effects of Radiation Quenching, Ion Bombardment and Annealing on Catalytic Activity of Pure Nickel and Platinum Surfaces. II. Hydrogenation of Ethylene (continued), Hydrogen-Deuterium Exchange."
 - c. Ar ion
67. Farnsworth, H. E., and R. F. Woodcock, *Ind. Eng. Chem.* 49, 258 (1957). "Radiation Quenching, Ion Bombardment and Annealing of Nickel and Platinum for Ethylene Hydrogenation."
 - c. Ar ion
68. Feldkirchner, H. L., and D. V. Kniebes, "Effect of Nuclear Irradiation on the Activity of Iron Methanation Catalysts," Paper presented at the 141st National American Chemical Society Meeting, Washington, D. C., March 21-29, 1962.
 - a. Methane production from CO and H_2
 - b. Raney iron, iron shot, "ammonia synthesis catalyst"
 - c. Gamma, neutron
69. Fiti, M., *Acad. Rep. Populare Romine, Studii Cercetari Fiz.* 12, 357 (1961). "The Nature of the Active Surface of Solid Catalysts. I. The Active Surface of Cr_2O_3 and NiO Determined from Radiochemical Data."
 - a. CO_2 chemisorption, C^{14} isotope exchange in CO_2
 - c. Co^{60}

70. Fulkerson, W., "Effects of the Decay of Sulfur-35 on Some Electrical Properties of Cadmium Sulfide Semiconducting Films," Ph.D. dissertation, Rice University, Houston, Texas, 1962.
- a. H₂-D₂ exchange
 - b. Vycor
 - c. Sr⁹⁰, S³⁵
71. German Patent 1,076,863, Esso Research and Engineering Co., (by H. J. Hibshman, R. W. Horton, J. P. Longwell, P. J. Lucchesi, R. B. Long, C. L. Read, and B. L. Tarmy), March 3, 1960. "Catalytic Conversion of Hydrocarbons."
- a. Liquid phase reforming, hydroforming, cracking, polymerization
 - b. Pt-Al₂O₃, "acid cracking catalyst" impregnated with BF₃, B₂O₃, NaBH₄ or LiNO₃, LiCH₃, LiAlH₄ enriched in Li⁶
 - c. Reactor
72. Gibson, E. J., R. W. Clarke, T. A. Dorling, and D. Pope, Proc. U. N. Intern. Conf. Peaceful Uses At. Energy, 2nd, Geneva, 1958 29, 312 (Pub. 1959). "The Effect of Ionizing Radiations on Solid Catalysts."
- a. Fischer-Tropsch synthesis
 - b. Fe₂O₃, "mill-scale"
 - c. Co⁶⁰
 - d. See also reference 50
73. Gotzky, S., and P. Gunther, Z. Physik. Chem. B 26, 373 (1934). "Excitation of the Hydrogen-Chlorine Reaction by X-rays."
- b. Cu, Ag
74. Graham, D., J. Phys. Chem. 66, 510 (1962). "Activation of Metal Hydrogenation Catalysts by Irradiation."
- a. Hydrogenation of nitrobenzene or p-nitrotoluene
 - b. Supported Ni, Pt, or Pd
 - c. 2-3 Mev electrons; 1-2 Mev x rays; 15-Mev deuterons, neutrons from Be cyclotron target

75. Graham, D., "Activation of Metal Hydrogenation Catalysts by Irradiation," Paper presented at 140th National Meeting of the American Chemical Society, Chicago, 1961.
 - d. See reference 74
76. Gromov, V. V., and V. I. Spitsyn, Dokl. Akad. Nauk SSSR 141, 891 (1961). "The Effect of External Irradiation on the Sorption Properties of BaSO₄."
 - a. Adsorption of acid orange and methylene blue from solution
 - c. electrons, protons
77. Gunther, P., Ergeb. Tech. Rontgenkunde 4, 100 (1934). "Acceleration of Reactions by X-rays and by Ions."
 - d. Review
78. Haissinsky, M., Actes. Congr. Intern. Catalyse 2^e, Paris, 1960 2, 1429 (Pub. 1961). "Heterogeneous Catalysis and Catalysts in Radiation Chemistry."
 - d. Review
79. Haissinsky, M., Jaderna Energie 7, 73 (1961). "Radiation Effects on Catalysts and the Influence of Catalysts on Radiolytic Reactions."
 - d. Review
80. Haissinsky, M., and M. Duflo, Compt. Rend. 246, 1206 (1958). "Radiochemical Reactions Catalyzed in Aqueous Solutions by Semiconductors and Metals."
 - a. Oxidation of KI, U(SO₄)₂; reduction of ferric o-phenanthroline
 - b. ThO₂, Ta₂O₅, Nb₂O₅, CoS, Pt black, Pd black, TiO₂
 - c. Co⁶⁰; x rays
 - d. See reference 81

81. Haissinsky, M., and M. Duflo, Proc. U. N. Intern. Conf. Peaceful Uses At. Energy, 2nd, Geneva, 1958 29, 47 (Pub. 1959). "Heterogeneous Catalysis in Radiation Chemistry."
 - a. Reduction of methylene blue in addition to those given above
 - b. See reference 80
82. Haissinsky, M., and A. M. Pujo, Compt. Rend. 240, 2530 (1955). "Heterogeneous Catalysis in Radiation Chemistry."
 - a. Reduction of Ag_2SO_4 , H_2O_2 decomposition, oxidation of FeSO_4 or $\text{U}(\text{SO}_4)_2$
 - b. Ag, Au, BaSO_4 , magnesium silicate
 - c. Co^{60}
83. Haissinsky, M., and J. Siejka, J. Chem. Phys. 56, 702 (1959). "The Effect of Gamma-rays on the Adsorption of Ions in Aqueous Solution."
 - a. Adsorption of Ce^{3+} , Cs^+ and I^-
 - b. Pt, stainless steel and polyvinyl chloride
 - c. Co^{60}
84. Harker, G., J. Cancer Research, Comm. Univ. Sydney 4, 109 (1932). Radiosensitivity from the Chemical Viewpoint."
 - a. H_2 adsorption
 - b. Pd black
85. Harker, G., J. Soc. Chem. Ind. 51, 314T (1932). "The Effect of X- and Gamma-Irradiation on Adsorption."
 - a. C_2H_4 hydrogenation, H_2 adsorption
 - b. Cu, Pd
86. Henley, E. J., Large Radiation Sources Ind. Proc. Conf. Warsaw, 1959, 2, 165 (Pub. 1960). "The Effect of Nuclear Radiation on Coal and Methanation Reactions."
 - b. SnCl_2 , calcium hydride, sodium borohydride, sodium Co^{60}
 - c. Co^{60}
 - d. Brief statement in abstract that radiation did not enhance catalytic effects

87. Hentz, R. R., J. Phys. Chem. 65, 1470 (1961). "Gamma-Irradiation of Isopropylbenzene Adsorbed on Microporous Silica-Alumina."
88. Hentz, R. R., J. Phys. Chem. 66, 1625 (1962). "Irradiation of Isopropylbenzene Adsorbed on Microporous Silica-Alumina."
- c. Co^{60}
89. Hentz, R. R., J. Phys. Chem. 66, 2714 (1962). "Isopropylbenzene Conversion on Pre-irradiated Silica-Alumina."
- c. Co^{60}
90. Herczynska, E., Naturwissenschaften 47, 224 (1960). "Enhanced Adsorption as a Result of Irradiation of Metals."
- a. Adsorption of Cs^+ and $\text{SO}_4^{=}$ from solution
- b. Au, Pt
- c. Co^{60}
91. Hirayama, T., and M. Nitto, "Research on the Activation of Silica-Alumina Catalyst by Irradiation," Paper presented at the 3rd Japan Conf. on Radioisotopes, Sept. 1959 (Abstract No. 59/P-174, R-34).
- a. Cumene cracking, n-hexane isomerization
- c. neutron, gamma (source unspecified)
92. Hirota, K., S. Sakuyama, and G. Meshituka, Nippon Kagaku Zasshi 78, 981 (1957), Trans. UKAEA, Np-tr-223, "The Effect of Gamma-ray Irradiation on a Solid Catalyst."
- a. SO_2 oxidation
- b. $\text{V}_2\text{O}_5-\text{K}_2\text{O}-\text{SiO}_2$; $\text{V}_2\text{O}_5-\text{K}_2\text{O}$ -diatomaceous earth
- c. Co^{60}
93. Hoigne, J., and D. Ballantine, "Irradiation Induced Effects in Magnesium Oxide Catalysts," BNL-5592.
- a. o-p hydrogen conversion
- c. Co^{60}
- d. See reference 94

94. Hoigne, J., and D. Ballantine, "Radiation Induced Effects in Magnesium Oxide Catalysts," BNL-686, April 6, 1961
 - a. o-p hydrogen conversion, H₂ and CO adsorption
 - b. MgO, ZnO
 - c. Co⁶⁰
 - d. See references 33-38
95. Italian Patent 547,583, Baccaredda, M., Sept. 8, 1956, "Activation of Solid Catalysts by High-energy Radiation Derived from Atomic Piles or Accelerators."
 - a. Hydrogenation of unsaturated hydrocarbons, oxidation of C₂H₄, decomposition of methanol and ethanol
 - b. Cu-Ni; Pt on Ag; Al silicate
 - c. 30-Mev electrons
96. Kailan, A., Chem. Ber. 55B, 2492 (1922), Observations on Schwarz' and Friedrich's paper, "Influence of Rontgen Rays on the Catalysis of Hydrogen Peroxide by Platinum."
97. Kircher, J. F., Process Radiation Development - Program Summaries, TID-7645, 1962, p 21. "An Investigation of the Feasibility of Obtaining Enhanced Catalytic Activity from Internal Irradiation of Catalysts."
 - d. Briefly discusses proposed BMI Program (See reference 141)
98. Kohn, H. W., Chem. Div. Ann. Prog. Report, Period Ending June 20, 1961, ORNL-3176, p 26. "Radiation Damage of Silica Gel."
 - a. H₂-D₂ exchange
 - c. Co⁶⁰
99. Kohn, H. W., Chem. Div, Ann. Prog. Report, Period Ending June 20, 1962, ORNL-3320, p 34. "Radiation Effects on Surface Reactivity of Silica Gel."
 - a. H₂-D₂ exchange, irradiation of adsorbed organics
 - c. Co⁶⁰
 - d. See reference 100

100. Kohn, H. W., J. Phys. Chem. 66, 1185 (1962). "Surface Carbonium Ions Produced by Irradiating Silica Gel."
 - a. Irradiation of 17 different adsorbed organic materials
 - b. SiO_2 gel; $\text{SiO}_2\text{-Al}_2\text{O}_3$
 - c. Co^{60}
101. Kohn, H. W., Nature 184, 630 (1959). "Color Centres Produced by Radiation in Silica Gel."
 - a. Includes H_2 adsorption
 - b. SiO_2 gel, $\text{SiO}_2\text{-Al}_2\text{O}_3$
 - c. Co^{60} , x rays
102. Kohn, H. W., L. J. E. Hofer, F. S. Karn, and R. B. Anderson, U. S. Bureau of Mines, Branch of Coal-to-Oil Research Division of Solid Fuels Technology, Project No. 3451-33 (1960).
 - a. Fischer-Tropsch synthesis
 - b. Iron oxide
 - c. Radon alpha particles
 - d. Information from personal communication with H. W. Kohn
103. Kohn, H. W., G. E. Moore, and E. H. Taylor, Chem. Div. Ann. Prog. Report, Period Ending June 20, 1958, ORNL-2584, p 18, "Effect of Ionizing Radiation on Catalysts."
 - a. $\text{H}_2\text{-D}_2$ exchange
 - b. $\gamma\text{-Al}_2\text{O}_3$, ZnO , SiO_2 gel, TiO_2 (rutile and anatase), ThO_2 , BaTiO_3 , MgO , V_2O_3 , $\text{SiO}_2\text{-Al}_2\text{O}_3$, "Hydrides"
 - c. Co^{60} , reactor, radon alpha particles
104. Kohn, H. W., and G. E. Moore, Chem. Div. Ann. Prog. Report, Period Ending June 20, 1959, ORNL-2782, p 27, "Effects of Ionizing Radiation on Catalysts."
 - a. $\text{H}_2\text{-D}_2$ exchange,
 - b. SiO_2 , $\text{SiO}_2\text{-Al}_2\text{O}_3$, Pt, Ni, Cu, Ge, Au, Ag, activated C
 - c. Co^{60} , neutron, x ray

105. Kohn, H. W., and E. H. Taylor, Actes Congr. Intern. Catalyse 2^e. Paris, 1960 2, 1461 (Pub. 1961). "The Effect of Ionizing Radiation on the Surface Properties of Silica Gel."
- a. H₂-D₂ exchange, H₂ adsorption, C₂H₄ hydrogenation
 - b. SiO₂
 - c. Co⁶⁰, x rays, reactor.
106. Kohn, H. W., and E. H. Taylor, Chem. Div. Semiannual Prog. Report, Period Ending Dec. 20, 1955, ORNL-2046, p 66. "Effect of Ionizing Radiation on Heterogeneous Catalysts."
- a. H₂-D₂ exchange
 - b. ZnO
 - c. Co⁶⁰
107. Kohn, H. W., and E. H. Taylor, Chem. Div. Semiannual Prog. Report, Period Ending June 20, 1956, ORNL-2159, p 21. "Effect of Ionizing Radiation on Heterogeneous Catalysts."
- a. H₂-D₂ exchange
 - b. ZnO, γ -Al₂O₃
 - c. Co⁶⁰
108. Kohn, H. W., and E. H. Taylor, Chem. Div. Ann. Prog. Report, Period Ending June 20, 1957, ORNL-2386, p 24. "Effect of Ionizing Radiation on Heterogeneous Catalysts."
- a. H₂-D₂ exchange
 - b. Al₂O₃, ZnO, V₂O₃, MgO, BaH₂, LiH, TiO₂
 - c. Co⁶⁰, fast neutrons, alpha particles
109. Kohn, H. W., and E. H. Taylor, Chem. Div. Ann. Prog. Report, Period Ending June 20, 1960, ORNL-2983, p 26. "Effect of Ionizing Radiation on Catalysts - Nonmetals."
- a. o-p hydrogen conversion, H₂-D₂ exchange, C₂H₄ hydrogenation, H₂ and O₂ adsorption
 - b. SiO₂ gel
 - c. Co⁶⁰, neutrons, x rays

110. Kohn, H. W., and E. H. Taylor, J. Phys. Chem. 63, 500 (1959). "The Effect of Ionizing Radiation upon Gamma-Al₂O₃ as a Catalyst for H₂-D₂ Exchange."
- c. Co⁶⁰, reactor, Radon alpha particles
 - d. Brief statement on ZnO, TiO₂, MgO results included
111. Kohn, H. W., and E. H. Taylor, J. Phys. Chem. 63, 966 (1959). "The Hydrogen-Deuterium Exchange Activity and Radiation Behavior of Some Silica Catalyst."
- b. SiO₂, SiO₂-Al₂O₃
 - c. Co⁶⁰, reactor
112. Kohn, H. W., and E. H. Taylor, "Ionizing Radiation in the Study of Heterogeneous Catalysts," Paper presented at the 133rd Meeting of the American Chemical Society, San Francisco, April 1958.
- a. H₂-D₂ exchange
 - b. γ -Al₂O₃, MgO, ZnO, LiH
 - c. Co⁶⁰, fast neutrons, alpha particles
113. Kohn, H. W., and E. H. Taylor, "Modification of Surface Properties of Silica Gel by Radiation," Paper presented at 138th Meeting of the American Chemical Society, New York, Sept. 1960.
- a. o-p hydrogen conversion, H₂-D₂ exchange, H₂ and O₂ adsorption
 - c. Co⁶⁰
114. Kolbanovskii, Yu. A., I. M. Kustanovich, L. S. Polak, and A. S. Shcherbakova, Dokl. Akad. Nauk SSSR 129, 145 (1959). "The Electron Paramagnetic Resonance Spectra of Certain Catalysts and Catalyst-Hydrocarbon Systems, and the Action of Gamma-Radiation on them."
- a. Adsorbed n-heptane, n-heptene-1, cyclohexane, benzene
 - b. Al₂O₃, Al₂O₃-SiO₂, MoO₃-Al₂O₃, CoO-Al₂O₃-MoO₃, Al₂O₃, Cr₂O₃-K₂O, MoS₂
 - c. Co⁶⁰

115. Kolbanovskii, Yu. A., J. M. Kustanovich, L. S. Polak, and A. S. Shcherbakova, Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii. Akad. Nauk Uz. SSR 1, 191 (1961). "The Effects of Gamma-Radiation on Oxide Catalysts and on Systems: Catalysts-Adsorbed Hydrocarbons."
- a. Adsorption of heptane, heptene, benzene, cyclohexane
 - b. Oxides containing Al, K, Si, Mo (See reference 114)
116. Kolbanovskii, Yu. A., L. S. Polak, and E. B. Shlikter, Dokl. Akad. Nauk SSSR 136, 147 (1961). "The Gamma Radiolysis of n-heptane Adsorbed on Oxide Catalysts."
- b. Al_2O_3 , $\text{Al}_2\text{O}_3\text{-Cr}_2\text{O}_3\text{-K}_2\text{O}$, MoO_3 , $\text{Al}_2\text{O}_3\text{-MoO}_3\text{-CoO}$
117. Kramer, H., Process Radiation Development - Program Summaries, TID-7645, p 37, 1962. "Radiolysis of Ammonia and Aqueous Ammonia."
- d. See references 40-41
118. Krohn, N. A., Chem. Tech. Div. Ann. Prog. Report, Period Ending June 30, 1962, ORNL-3314, p 184. "Radiation Effects on Catalysts."
- a. Dehydration of cyclohexanol
 - b. MgSO_4 , $\text{MgSO}_4\text{-Na}_2\text{SO}_4$
 - c. Incorporated S^{35}
119. Krohn, N. A., "The Influence of Incorporated Radioactivity and External Radiation on the Dehydration of Cyclohexanol over Sulfate Catalysts," PhD dissertation, University of Tennessee, 1962, Dissert. Abstr. 23, 1943 (1962).
- b. MgSO_4 , $\text{MgSO}_4\text{-Na}_2\text{SO}_4$
 - c. Incorporated S^{35} , Co^{60} , 180-300 kv x rays
120. Krohn, N. A., and H. A. Smith, J. Phys. Chem. 65, 1919 (1961). "The Influence of X-rays on Catalytic Activity as Related to Incorporated Radioactivity."
- a. Dehydration of cyclohexanol
 - b. MgSO_4 , $\text{MgSO}_4\text{-Na}_2\text{SO}_4$
 - c. 180-300 kv x rays

121. Krohn, N. A., and H. A. Smith, 'The Influence of Incorporated Radioactivity and External Radiations on Sulfate Catalysts,' Paper presented at the 142nd National Meeting of the American Chemical Society, Atlantic City, Sept. 1962.
 - d. See reference 119
122. Krohn, N. A., and R. G. Wymer, Chem. Tech. Div. Ann. Prog. Report, Period Ending Aug. 31, 1960, ORNL-2993, p 183. "Radiation Effects on Catalysts."
 - a. Dehydration of cyclohexanol, dehydrogenation of methyl-cyclohexane
 - b. $MgSO_4-Na_2SO_4$, $Cr_2O_3-Al_2O_3$
 - c. Co^{60} , incorporated S^{35} , incorporated Pm^{147}
 - d. Preliminary results
123. Krohn, N. A., and R. G. Wymer, Chem. Tech. Div. Ann. Prog. Report, Period Ending May 31, 1961, ORNL-3153, p 121. "Radiation Effects on Catalysts."
 - a. See reference 122
 - b. $MgSO_4$, $MgSO_4-Na_2SO_4$, $Cr_2O_3-Al_2O_3$
 - c. 180-300 kv x rays, incorporated Pm^{147}
124. Kubo, T., and M. Taniguchi, Kogyo Kagaku Zasshi 60, 1225 (1957), "Effects of X-ray Irradiation on Oxidation of Sulfur Dioxide by Vanadia-Titania Catalysts."
125. Little, Arthur D., Inc., "Effects of Radiant Energy on the Synthesis of Gaseous Fuels," Report C-60548 to the Amer. Gas Assoc., Sept. 1957.
 - d. Includes discussion of commercial possibilities of radiation effects on catalysts
126. Little, Arthur D., Inc., "Radiation: A Tool for Industry," pp 188-193.
 - d. Brief review and discussion of commercial possibilities

127. Lucchesi, P. J., D. L. Baeder, and J. P. Longwell, *J. Am. Chem. Soc.* 81, 3235 (1959). "Stereospecific Isomerization of Butene-1 to Butene-2 over $\text{SiO}_2\text{-Al}_2\text{O}_3$ Catalyst."
- c. Reactor
128. Lucchesi, P. J., D. L. Baeder, and J. P. Longwell, *Proceedings of the Fifth World Petroleum Congress*, 10, 97 (1959). "Radiation Promoted Hydrocarbon Reactions."
- a. Isomerization of n-hexane and methylcyclopentane
- b. AlCl_3
- c. Co^{60} , x rays
129. Lucchesi, P. J., D. L. Baeder, J. P. Longwell, and M. C. Schroeder, *J. Chem. Phys.* 31, 558 (1959). "Effect of Neutron Irradiation on the Activity of Silica-Alumina Catalyst for the Double Bond Isomerization of Butene-1."
- c. Reactor
130. Lucchesi, P. J., C. E. Heath, and D. L. Baeder, *J. Am. Chem. Soc.* 82, 4530 (1960). "Radiation-induced Carbonium Ion Reactions and the Chain Nature of Acid Catalyzed Isomerization."
- d. See reference 128
131. Lunsford, J. H., "Effects of Irradiation on the Catalytic Activity of Metal Oxides," Ph.D. dissertation, Rice University, Houston, Texas, Sept. 1961.
- a. $\text{H}_2\text{-D}_2$ exchange
- b. MgO , SiO_2 gel, ZnO
- c. Reactor, ultraviolet
132. Lunsford, J. H., and T. W. Leland, *J. Phys. Chem.* 66, 2591 (1962). "Effects of Neutron and Ultraviolet Irradiation on the Catalytic Activity of Magnesium Oxide."
- a. $\text{H}_2\text{-D}_2$ exchange
- d. See also reference 131

133. Luyckx, A., Bull. Soc. Chim. Belges. 43, 160 (1934). "Negative Catalysis by Platinized Walls of the Radiochemical Decomposition of Ammonia."
- c. Radon alpha particles
134. Manowitz, B., Proceedings of the Inter-American Symposium on the Peaceful Application of Nuclear Energy, TID-755⁴, May 1957, p 318. "Chemical Applications of Radiation."
- d. Review
135. Mason, E. A., R. C. Reid, and N. J. Stevens, "The Effect of Electron Irradiation Prior to Reaction on the Activity of a Semiconductor Catalyst," NYO-9217, Sept. 1961.
- a. CO oxidation
- b. Cu₂O
- c. 3.5-Mev electrons
- d. See references 201-203
136. Maurin, J., D. Ballentine, and J. Sucher, "The Effect of Ionizing Radiation on Hydrogen Conversion over Oxide Catalysts," BNL-3786.
- a. o-p hydrogen conversion
- b. Alpha-alumina, gamma-alumina, Fe₂O₃, MoO₃, Mo₂O₃, Al₂O₃-MoO₃
- c. Co⁶⁰
- d. See references 32-34, 137
137. Maurin, J., D. Ballentine, and J. Sucher, "The Effect of Ionizing Radiation on Hydrogen Conversion over Oxide Catalysts," BNL-3983.
- d. See references 32-34, 136
138. McBride, J. P., and W. L. Pattison, Chem. Tech. Div. Ann. Prog. Report, Period Ending June 30, 1962, ORNL-331⁴, p 176. "Effect of Irradiation on Palladium-Thoria Catalyst."
- c. Reactor
- d. See reference 139

139. McBride, J. P., and W. L. Pattison, "Gas Recombination Activity of Irradiated Slurry from Loop L-2-27S," ORNL CF-62-2-88, Feb. 1962.
- H₂-O₂ recombination
 - Pd-ThO₂ (aqueous slurry)
 - Reactor
140. McDonald, T. F., "Variation in the Adsorption of Hydrogen by Silica Gel as a Result of Gamma Irradiation," M.S.thesis, Chem. Eng. Dept., Columbia University, 1961.
141. McFarling, J. L., J. F. Kircher, and D. N. Sunderman, Battelle Memorial Institute Quarterly Progress Report No. 13, BMI-X-10009. "Radioisotope and Radiation Applications."
 - Dehydration of cyclohexanol
 - MgSO₄-CaCl₂ containing UO₂ particles
 - Reactor, fission products
142. McFarling, J. L., J. F. Kircher, and D. N. Sunderman, Progress Relating to Civilian Applications During May 1962, BMI-1581 (Del.) p. H-6. "A Study of the Effect of Internal Irradiation on Catalyst Activity."
 - See reference 141 and 258
143. McFarling, J. L., J. F. Kircher, and D. N. Sunderman, Progress Relating to Civilian Applications During June 1962, BMI-1583 (Del.) p H-4. "A Study of the Effect of Internal Irradiation on Catalyst Activity."
 - See reference 141 and 258
144. McFarling, J. L., J. F. Kircher, and D. N. Sunderman, Progress Relating to Civilian Applications During July 1962, BMI-1589 (Del.) p H-4. "A Study of the Effect of Internal Radiation on Catalyst Activity."
 - See reference 141 and 258

145. McFarling, J. L., J. F. Kircher, and D. N. Sunderman, Progress Relating to Civilian Applications During August 1962, BMI-1593 (Del.), p H-4. "A Study of the Effect of Internal Irradiation on Catalyst Activity."
- d. See reference 141 and 258
146. Mechelynck-David, C., and F. Provost, Intern. J. Appl. Radiation Isotopes 10, 191 (1961). "Effect of Solid Additives on the Polymerization of Ethylene and on the Telomerization of Carbon Tetrachloride and Ethylene Initiated by Gamma Rays."
- b. SiO_2 gel, Al_2O_3 , activated C, molecular sieves, ZnO quartz wool, polyethylene powder
147. Mikovsky, R. J., and P. B. Weisz, J. Catalysis 1, 345 (1962). "Induction of Catalytic Activity by Neutron Irradiation of Silica and Silica-Alumina."
- a. Isomerization of butene-1
- c. Reactor
148. Minachev. Kh. M., Yu. S. Kodakov, Izv. Akad. Nauk SSSR Otd. Khim. Nauk 1961, 1430. "The Influence of Gamma-radiation on the Activity of Catalysts Containing Platinum."
- a. H_2O_2 decomposition
- b. Pt- Al_2O_3
- c. 0.6-Mev gamma
149. Minachev. Kh. M., M. A. Markov, Yu. S. Kodakov, Izv. Akad. Nauk SSSR Otd. Khim. Nauk 1961, 1227. "The Influence of Gamma-radiation on the Catalytic Activity of Platinized Aluminum Silicate."
- b. H_2O_2 decomposition, cyclohexene hydrogenation
- c. 0.6-Mev gamma

150. Mischenko. Yu. A., G. K. Boreskov, V. B. Kazanskii, and G. B. Pariiskii, *Kinetika i Kataliz* 2, 296 (1961); *Kinetics Catalysis* (USSR) (Eng. Transl.) 2, 277 (1961). "The Influence of Ionizing Radiation on the Catalytic and Magnetic Properties of Titanium Dioxide."
- a. H₂-D₂ exchange
 - c. Co⁶⁰
151. Moore, G. E., and E. H. Taylor, Chem. Div. Ann. Prog. Report, Period Ending June 20, 1960, ORNL-2983, p 26. "Effect of Ionizing Radiation on Catalysts - Metals and Elemental Semiconductors."
- a. H₂-D₂ exchange, HCOOH decomposition
 - b. Cu
 - c. Fast neutrons
152. Myerholtz, R. W., "The Effect of Gamma Irradiation on the Isomerizing Properties of an Alumina Catalyst," Ph.D. dissertation Part II-C, Northwestern University, 1955; Univ. Microfilms Publ. 13118; Dissert. Abstr. 15, 1725 (1955).
- a. Isomerization of cyclohexene to methylcyclopentenes
 - c. Co⁶⁰
153. Nachman, M., I. Maxim, and T. Braun, *Phys. Chem. Solids* 20, 307 (1961). "Radiation Induced Chemisorption of Oxygen on Chromia."
- a. Chemisorption of oxygen, decomposition of H₂O₂
 - b. Cr₂O₃, Cr₂O₃-Al₂O₃, Cr₂O₃-SnO₂
 - c. Reactor
154. Opalinska, I., and S. Ciborowski, *Roczniki Chem.* 36, 1369 (1962). "Effect of γ -Irradiation on the Catalytic Activity of Nickel."
- a. Hydrogenation of propylene
155. Panchenkov. G. M., V. I. Yakovlev, L. L. Kozlov, Yu. M. Zhorov, and D. A. Kuzovkin, *Zh. Fiz. Khim.* 36, 1113 (1962). "Activation of an Aluminosilicate Catalyst by Protons and γ -rays of Co⁶⁰."
- a. Cracking of isopropylbenzene

156. Pisarzhevskii, L., S. Chrelashvili, and G. Savchenko, Acta Physicochim. URSS 7, 289 (1937). "The Effect of X-rays on Catalysts During the Time of Their Action."
- H₂O₂ decomposition
 - Pt
157. Pisarzhevskii, L., S. Chrelashvili, and G. Savchenko, Zh. Fiz. Khim. 10, 534 (1937). "The Effect of X-rays on Catalysts During the Time of Their Action."
- Similar to reference 156
158. Preve, J., and R. Montarnal, Compt. Rend. 249, 1667 (1959). "Radiochemical Formation of Phenol Sensitized by Semiconductors."
- ZnO, ThO₂, ZnS, CuO, CaO, Al₂O₃, MgO, TiO₂
 - 200-kv x rays
159. Preve, J., and R. Montarnal, J. Chim. Phys. 58, 402 (1961). "Radiochemical Sensitization by Semiconductors."
- Formation of phenol from benzene
 - Those in reference 158 plus NiO, CdS, SiO₂
 - 200-kv x rays
160. Puig, J., Ind. At. 3, 5/6, 53 (1959). "Industrial Perspectives of Radiation Chemistry."
- Includes brief section on heterogeneous catalysis
161. Roberts, C. C., A. Spilners, and R. Smoluchowski, Bull. Am. Phys. Soc., Series 2 3, 116 (1958). "Effect of Proton Irradiation on the Catalytic Activity of Copper."
- HCOOH decomposition
162. Roberts, L. E. J., Adsorption on Irradiated Graphite, AERE-C/M. 144, April 1952.
- Chemisorption of O₂
 - Reactor

163. Roberts, R., "The Effect of Additives on the Low Temperature Cobalt-60 Initiated Polymerization of Isobutene," Proceedings of the International Symposium on Radiation Induced Polymerization and Graft Copolymerization, TID-7643, November 1962, p 17.
 - b. ZnO
164. Roberts, R., "Industrially Important Chemical Reactions Induced by Radiation," in E. Glueckauf (ed) Atomic Energy Waste; Its Nature, Use and Disposal, Butterworths, London, 1961, pp 388-411.
 - d. Includes brief review of the effects of radiation on catalysts
165. Rosenblatt, D. B., G. J. Dienes, J. C. Rothmann, Bull. Am. Phys. Soc. Series 2, 5, 167 (1960). "Effect of Reactor Irradiation Upon Hydrogen Adsorption by an Alumina Catalyst."
166. Roux, B., Chim. Mod. 6, 221 (1961). "Use of Gamma and X-rays in Chemical Synthesis."
 - d. Review including effects on heterogeneous catalysis
167. Saito, Y., Y. Yoneda, S. Makishima, Nature 183, 388 (1959). "Effect of Thermal Neutron Irradiation on Oxide Catalysts for the Decomposition of Nitrous Oxide."
 - b. NiO, Al_2O_3 and SnO_2 impregnated with Li_2O or B_2O_3
 - c. Reactor and α particles from n,α reactions
168. Schlier, R. E., and H. E. Farnsworth, Advan. Catalysis 9, 434 (1957). "Low-energy Electron Diffraction Studies of Oxygen Adsorption and Oxide Formation on a (100) Crystal Face of Nickel Cleaned Under High-vacuum Conditions."
 - c. Ar ions

169. Schwab. G. M., R. Sizmann, and N. Todo, Z. Naturforsch. 16A, 985 (1961). "The Alteration of the Catalytic Activity of Copper by Alpha-Irradiation."
- C_2H_4 hydrogenation
 - Po^{210} alpha particles
170. Schwarz, R., and W. Friedrich, Chem. Ber. 55B, 1040 (1922). "On the Influence of X-rays on the Platinum Catalysis of Hydrogen Peroxide."
171. Schwarz, R., and M. Klingenfuss, Z. Elektrochem. 28, 472 (1922). "Activation of Contact-platinum by Röntgen Rays."
- SO_2 oxidation
172. Schwarz, R., and M. Klingenfuss, Z. Elektrochem. 29, 470 (1923). "On the Nature of X-ray Effects on Contact Platinum."
- SO_2 oxidation
173. Selke, W. A., S. Engel, C. Kardys, R. C. Jagel, and E. V. Sherry, "Utilization of Waste Fission Products in Chemical Reactions," NYO-3328, April 1, 1952.
- NH_3 synthesis
 - Glass wool, steel wool
 - Co^{60}
 - See reference 57
174. Selke, W. A., C. Kardys, E. V. Sherry, and R. C. Jagel, "Utilization of Waste Fission Products in Chemical Reactions," NYO-3327, Jan. 1, 1952.
- See reference 173

175. Shankar, J. S., B. Srivastava, and M. H. Rao, Chemical Effects of Nuclear Transformations, Proceedings of the Symposium, Prague, 1960, 2, 327 (Pub. 1961). "Effects of Pile Radiation on the Catalytic Activity of Manganese Dioxide."
- a. H_2O_2 decomposition
 - c. Reactor, x-ray, gamma (Cd-shielded sample in reactor pool)
176. Shooter, D., and H. E. Farnsworth, J. Phys. Chem. 66, 222 (1962). "A Search for Hydrogen-Deuterium Exchange on Clean Germanium Surfaces."
- c. Ar ions
177. Shooter, D., and H. E. Farnsworth, Phys. Chem. Solids 21, 219 (1961). "Hydrogen-Deuterium Exchange on Clean Nickel Surfaces."
- c. Ar ions
178. Shub, D. M., G. S. Tyurikov, and V. I. Veselovsky, 1st All-Union Conf. on Radiation Chemistry, Moscow, 1957, p 160. "Radiation Sensitization by Means of Oxide Semiconductors in Reactions of Formation and Decomposition of Hydrogen Peroxide in Aqueous Solutions under the Action of Gamma-radiation."
- b. ZnO , Al_2O_3
179. Shub, D. M., G. S. Tyurikov, and V. I. Veselovsky, Zh. Fiz. Khim. 34, 2245 (1961). "Photochemical and Radiation-Induced Decomposition of Hydrogen Peroxide in the Presence of Ferric Oxide."
- c. Co^{60}
180. Siejka, J., and M. Haissinsky, J. Chim. Phys. 57, 1090 (1960). "Effects of Gamma-rays and Degassing on the Adsorption of Ions in Aqueous Solution."
- a. Adsorption of Ce^{3+} , Cs^+ and I^-
 - b. Pt, polyvinyl chloride, stainless steel

181. Sizmann, R., "Reactivity of Solids," Proc. Intern. Symp. Reactivity of Solids, 4th, Amsterdam, 1960 (Pub. 1961) p 478.
 - a. Hydrogenation of ethylene
 - b. Cu
 - c. Po^{210} alpha particles
 - d. See reference 169
182. Smoluchowski, R., Radiation Res. Supplement 1, 26 (1959). "Radiation Effects in Solids."
 - d. Review including brief treatment of HCOOH decomposition on Cu, see references 161 186, and 187
183. Sosnovsky, H. M. C., Phys. Chem. Solids 10, 304 (1959). "The Catalytic Activity of Silver Crystals of Various Orientations after Bombardment with Positive Ions.
 - a. HCOOH decomposition
 - c. Ar ions
184. Sosnovsky, H. M. C., "Radiation Effects on Semiconductor Catalysts, ASD-TDR-62-233, October 1962.
 - a. $\text{H}_2\text{-D}_2$ exchange
 - b. Ge
 - c. Fast neutrons
185. Sosnovsky, H. M. C., G. J. Ogilvie, and E. Gillam, Nature 182, 523 (1958). "Catalytic Activity and Surface Structure after Ion Bombardment."
 - a. HCOOH decomposition
 - b. Ag
 - c. Ar ions
186. Spilners, A., and R. Smoluchowski, "Effect of Proton Irradiation on Catalytic Activity," Paper presented at 138th Meeting of the American Chemical Society, New York, Sept. 1960.
 - a. HCOOH decomposition
 - b. Cu
 - c. 350-Mev protons
 - d. See references 161, 182, and 187

187. Spilners, A., and R. Smoluchowski, Reactivity of Solids, Proc. Intern. Symp. Reactivity Solids, 4th, Amsterdam, 1960, J. H. DeBoer (Ed), Elsevier, 1961, p 475. "Effect of Proton Irradiation upon Catalytic Activity."
 - d. See reference 186, results using Ni catalyst mentioned
188. Spitsyn, V. I., Izv. Akad. Nauk SSSR Otd. Khim. Nauk 1958, 1296. "The Effect of Radioactive Radiation on the Physical Chemical Properties of Solid Bodies."
 - d. Review of Russian work including effects on adsorption and heterogeneous catalysis
189. Spitsyn, V. I., Izv. Akad. Nauk SSSR Otd. Khim. Nauk 1960, 1325. "New Data on the Effect of Radioactive Radiation on Solids and External Radiation on Some Heterogeneous Chemical Processes."
 - d. Good review of Russian work
190. Spitsyn, V. I., Magy. Tud. Akad. Kem. Tud. Oszt., Kozlemen.18, 301 (1962). "Effect of the Radioactive Radiation of Solid Bodies and of External Radiation on Some Heterogeneous Chemical Processes."
 - d. Review
191. Spitsyn, V. I., A. A. Balandin, I. E. Mikhailenko, and N. P. Dobrosel'skaya, Dokl. Akad. Nauk SSSR 146, 1128 (1962). "Dehydration of Isopropyl Alcohol on a Radioactive Tricalcium Phosphate Catalyst."
 - c. Incorporated Ca⁴⁵ and P³²
192. Spitsyn, V. I., and V. V. Gromov, Dokl. Akad. Nauk SSSR 123, 722 (1958). "The Effect of Radioactivity on the Sorptive Properties of Barium Sulfate."
 - a. Adsorption of dyes from solution (methylene blue, acid orange, brilliant green)
 - c. Incorporated S³⁵

193. Spitsyn, V. I., and V. V. Gromov, *Radiokhymia*, 1, 181 (1959). "The Problem of the Effect of the Radioactivity of Precipitates on their Sorption Properties."
- a. Adsorption of methylene blue, acid orange
 - b. BaSO_4
 - c. Incorporated S^{35} or Ra
194. Spitsyn, V. I., I. Maxim, G. N. Pirogova, I. E. Mikhailenko, P. O. Kodochigov, *Dokl. Akad. Nauk SSSR* 141, 1143 (1961). "Effect of Different Kinds of Radiation on the Catalytic Dehydration of n-Decyl Alcohol."
- b. Al_2O_3
 - c. Reactor, incorporated Ce^{144} , 760-kev electrons
195. Spitsyn, V. I., I. E. Mikhailenko, A. V. Kiselev, and L. D. Belyakova, *Izv. Akad. Nauk SSSR Otd. Khim. Nauk* 1960, 1311. "Adsorption of Methanol on Potassium Sulfate Labeled with S^{35} ."
196. Spitsyn, V. I., I. E. Mikhailenko, and G. N. Pirogova, *Dokl. Akad. Nauk SSSR* 140, 1090 (1961). "The Dehydration of n-Dodecyl Alcohol Over Magnesium Sulfate."
- a. Includes cyclohexanol dehydration experiment
 - c. Incorporated S^{35} , 800-kev electrons
197. Spitsyn, V. I., I. E. Mikhailenko, G. N. Pirogova, *Dokl. Akad. Nauk SSSR* 143, 1152 (1962). "The Influence of Ionizing Radiation on the Catalytic Activity of Aluminum Oxide in the Dehydration of n-Dodecyl Alcohol."
- c. Reactor, Ca^{45} incorporated as CaCl_2 , 800-kev electrons
198. Spitsyn, V. I., G. N. Pirogova, and I. E. Mikhailenko, *Izv. Akad. Nauk SSSR, Otd. Khim. Nauk* 1962, 1515. "Effect of Ionizing Radiation on Catalytic Dehydration of n-Dodecyl Alcohol."
- b. Al_2O_3 , $\text{Al}_2\text{O}_3\text{-P}_2\text{O}_5$; Al_2O_3 impregnated with H_2SO_4 or Na_2SO_4
 - c. Incorporated P^{32} , Ce^{144} , S^{35} or Cs^{137} ; reactor, 760-kev electrons

199. Starodubtsev, S. V., Sh. A. Ablyaeve, S. E. Ermakov, Dokl. Akad. Nauk SSSR 129, 72 (1959); Soviet Physics - Doklady 4, 1259 (1960).
"Variations in the Adsorption Properties of Silica Gel under the Action of Gamma-irradiation."
 - a. Adsorption of H₂, N₂, Ar, CO₂, CO, NH₃, C₂H₄, H₂S
 - d. See also reference 1
200. Steinberg, M., "Radiation Processing Report No. 1, Gamma-irradiation Experiments in the N₂-O₂ System," BNL-612, June 1960.
 - b. U₃O₈, Stainless steel, Cr, Ni, Fe₂O₃, Al₂O₃
201. Stevens, N. J., "The Effect of Irradiation Prior to Reaction on Catalyst Activity," Quarterly Progress Report No. 3, TID-6402, July 1960.
 - a. CO oxidation
 - b. ZnO, Cu₂O
 - c. 3-Mev electrons
 - d. See references 135 and 203
202. Stevens, N. J., "The Effect of Beta-irradiation Prior to Reaction on Catalyst Activity," Quarterly Progress Report No. 4, TID-11116, November 1960.
 - d. See references 135 and 203
203. Stevens, N. J., E. A. Mason, and R. C. Reid, J. Phys. Chem. 66. 2613 (1962). "The Effect of Electron Irradiation Prior to Reaction on the Activity of a Semiconductor Catalyst."
 - a. CO oxidation
 - b. Cu₂O
 - c. 3.5-Mev electrons
 - d. See reference 135
204. Sutherland, J. W., and A. O. Allen, J. Am. Chem. Soc. 83, 1040 (1961). "Radiolysis of Pentane in the Adsorbed State."
 - b. Molecular sieves, silica gel
 - c. Co⁶⁰

205. Sutherland, J. W., and A. O. Allen, Large Radiation Sources Ind., Proc. Conf., Warsaw, 1959,2, 3 (1960). "Radiolysis in the Adsorbed State."
 - d. See reference 204
206. Tagieva, M. M., and V. F. Kiselev, Zh. Fiz. Khim. 35, 1381 (1961). "The Action of Gamma-Radiation on the Surface Properties of Silica."
 - a. Adsorption of H₂O, O₂; H₂O radiolysis
 - c. Co⁶⁰
207. Taylor, E. H., J. Chem. Educ. 36, 396 (1959). "Radiation Effects on Solids, Including Catalysts."
 - d. Review
208. Taylor, E. H., Nucleonics 20, No. 1, 53 (1962). "Irradiation Effects on Catalysts."
 - d. Review
209. Taylor, E. H., and H. W. Kohn, J. Am. Chem. Soc. 79, 252 (1957). "An Enhancement of Catalytic Activity by Gamma Radiation."
 - a. H₂-D₂ exchange
 - b. Al₂O₃
210. Taylor, E. H., H. W. Kohn, and G. E. Moore, Large Radiation Sources Ind., Proc. Conf., Warsaw, 1959,2, 119 (Pub. 1960). "The Use of Ionizing Radiation in Heterogeneous Catalysis."
 - d. Review
211. Taylor, E. H., and J. A. Wethington, J. Am. Chem. Soc. 76, 971 (1954). "The Effects of Ionizing Radiation on Heterogeneous Catalysts - Zinc Oxide as a Catalyst for the Hydrogenation of Ethylene."
 - c. Co⁶⁰

212. Teller, A. J., F. L. Poska, and H. A. Davies, "Effect of Gamma Irradiation on the Catalytic Activity of Zinc Oxide and Chromic Oxide for the Decomposition of Methanol," Paper presented at the 42nd National Meeting of the AIChE, Atlanta, Feb. 1960.
- d. See reference 213
213. Teller, A. J., F. L. Poska, and H. A. Davies, Intern. J. Appl. Radiation Isotopes 11, 123 (1961). "Effect of Gamma-irradiation on the Catalytic Activity of Zinc Oxide and Chromic Oxide for the Decomposition of Methanol."
- d. See reference 59
214. Tetenyi, P., and L. Babernics, Dokl. Akad. Nauk SSSR 143, 616 (1962). "Effect of Irradiation on the Catalytic Properties of Copper."
- a. Dehydrogenation of cyclohexane
- c. Co^{60} , reactor
215. Todo, N., Tokyo Kogyo Shikensho Hokoku 57, 160 (1962). "Effect of Gamma Radiation on Methanol Decomposition with Zinc Oxide."
216. Topchiev, A. V., Yu. A. Kolbanovskii, L. S. Polak, Yu. L. Khait, and E. B. Shlikhter, Neftekhimiya 1, No. 1, 105 (1961). "Radiolysis of Alkanes Adsorbed on Semiconductor Catalysts."
- a. Radiolysis of n-heptane
- b. $\gamma\text{-Al}_2\text{O}_3$, $\text{Al}_2\text{O}_3\text{-Cr}_2\text{O}_3$, $\text{Al}_2\text{O}_3\text{-Mo}_2\text{O}_3$, $\text{Al}_2\text{O}_3\text{-Mo}_2\text{O}_3\text{-Co}_2\text{O}_3$
- c. Co^{60}
217. Traynard, P., and L. Orsini, Compt. Rend. 252, 873 (1961). "Irradiation of Industrial Cracking Catalysts in a Nuclear Reactor."
- a. Cumene cracking
- b. $\text{SiO}_2\text{-Al}_2\text{O}_3$, $\text{SiO}_2\text{-Al}_2\text{O}_3$ doped with Ir, Au, Zn, Vd
- c. Reactor; impregnated with S^{35}

218. Tsetskhladze, T. V., and G. Sh. Kalandadze, Tr. Inst. Fiz. Akad. Nauk Gruz. SSR 6, 61 (Pub. 1959). "Effects of Gamma-rays on the Catalytic Activity of Copper Oxides in the Reaction of Dehydrogenation of Ethyl Alcohol."
219. Turkevich, J., Large Radiation Sources Ind., Proc. Conf., Warsaw, 1959, 2, 111 (1960). "Radiation Damage to Solids and Catalysts."
 - d. Concerned primarily with luminescence of ZnS; includes brief report of work given in reference 221
220. Turkevich, J., Management and Atomic Energy, Proceedings of a Conference Sponsored by Atomic Industrial Forum, Inc., and National Industrial Conference Board, Chicago, March 1958, p 377. "Effect of Radiation on Catalytic Reactions."
 - d. Review
221. Turkevich, J., Proc. U. N. Intern. Conf. Peaceful Uses At. Energy, 2nd, Geneva, 1958 29, 375 (Pub. 1959). "The Use of Isotopes and Radiation in the Study of Heterogeneous Catalysis."
 - a. o-p hydrogen conversion, H_2 - D_2 exchange
 - b. Charcoal
 - c. Gamma (source not specified)
 - d. Reviews other work
222. Tuul, J., and H. E. Farnsworth, J. Am. Chem. Soc. 83, 2247 (1961). "Dependence of Activity and Activation Energy on Surface Treatment of Nickel and Copper-Nickel Catalysts."
 - a. C_2H_4 hydrogenation
 - d. Ar ions
223. Tuul, J., and H. E. Farnsworth, J. Am. Chem. Soc. 83, 2253 (1961). "Compensation Effect and Pressure Dependence for Ethylene Hydrogenation in Contact with Nickel."
 - d. See reference 222

224. Uhara, I., S. Yanagimoto, K. Tani, G. Adachi, and S. Teratani, J. Phys. Chem. 66, 2691 (1962). "The Structure of Active Centers in Copper Catalyst."
- a. Decomposition of benzene diazonium chloride
 - c. Neutron, Co⁶⁰
225. U. S. Patent 2,905,606, R. B. Long, H. J. Hibsham, J. P. Longwell, and R. W. Houston (to Esso Research and Engineering Co.), Sept. 22, 1959. "Low-Temperature Catalytic Conversion of Hydrocarbons by Neutron Irradiation."
- a. Hydrocracking
 - b. "Conventional cracking catalysts"
 - c. Reactor
226. U. S. Patent 2,905,607, R. B. Long, H. J. Hibsham, J. P. Longwell, and R. W. Houston (to Esso Research and Engineering Co.), Sept. 22, 1959. "Low-temperature Catalytic Conversion of Hydrocarbons by Neutron Irradiation."
- a. Isomerization of gas oil
 - b. SiO₂-Al₂O₃
 - c. Reactor
227. U. S. Patent 2,905, 608, C. R. Noddings, W. E. Miller, and T. C. Engelder (to Dow Chemical Co.), Sept. 22, 1952. "Irradiation of Catalysts Used to Dehydrogenate Unsaturated Hydrocarbons."
- d. See reference 27
228. U. S. Patent 2,951,796, S. L. Ruskin (to Union Carbide Corp.), Sept. 6, 1960. "Catalyzing Hydrocarbon Reactions, Especially Polymerization with Compounds Activated by Gamma Radiation."
- b. TiO₂, Al silicates containing ZrO₂, CrO₃, Zr, Th or Sr
 - c. Gamma source not specified

229. U. S. Patent 2,953,509, S. L. Ruskin (to Union Carbide Corp.), Sept. 20, 1960. "Gamma-ray Irradiation in the Catalytic Conversion of Petroleum."

Refined

- a. Hydrolysis of alkyl halides, conversion of alcohols to ethers, hydroforming, Friedel-Crafts synthesis, synthesis of aromatic aldehydes, diazotization, reactions of diazonium salts.
- b. Metal oxides, especially Pt oxide, V_2O_5 , Pb oxide; $PdCl_2$

230. U. S. Patent 2,959,529, R. B. Long, R. W. Houston, H. J. Hibshman, J. P. Longwell (to Esso Research and Engineering Co.), Nov. 8, 1960. "Conversion of Hydrocarbon in the Presence of Neutron Irradiation and a Catalyst."

- a. Conversion of gas oil to olefins
- b. H_3BO_3 -impregnated Al_2O_3

231. U. S. Patent 2,959,530, R. B. Long, P. J. Lucchesi, B. L. Tarmy, and C. L. Read (to Esso Research and Engineering Co.), Nov. 8, 1960. "Hydrogenation of Petroleum Hydrocarbons in the Presence of Neutron Irradiation and a Catalyst."

- a. Hydrogenation of cetane
- b. H_3BO_3 -impregnated Pt- Al_2O_3

232. U. S. Patent 2,962,430, J. P. Longwell, P. J. Lucchesi, and R. B. Long (to Esso Research and Engineering Co.), Nov. 29, 1960. "Radiochemical Conversion of Hydrocarbons in the Presence of a Catalyst."

- a. Radiolysis of hydrogenated kerosene
- b. Al_2O_3
- c. Reactor

233. U. S. Patent 2,962,431, E. M. Gladrow (to Esso Research and Engineering Co.), Nov. 29, 1960. "Radiochemical Conversion of Hydrocarbons in the Presence of an Activated Carbon Catalyst."

- a. Cetane conversion
- b. Activated C, $SiO_2-Al_2O_3$
- c. Reactor, Co^{60}

234. U. S. Patent 3,002,910, J. M. Caffrey, Jr. (to U. S. Atomic Energy Commission), Appl. Jan. 5, 1959. "Catalysts for Conversion of Hydrocarbons by Penetrating Radiation."
- a. Pentane radiolysis
 - b. SiO_2 gel
 - c. Co^{60}
 - d. See references 3, 45
235. U. S. Patent 3,018,235, B. L. Tarmy and R. B. Long (to Esso Research and Engineering Co.), Jan. 3, 1962. Radiochemical Hydrocarbon Conversion Process."
- a. Conversion of isobutane and isobutene to aromatics
 - b. $\text{SiO}_2\text{-Al}_2\text{O}_3$
 - c. Co^{60}
236. Vasil'eva, E. K., and S. V. Starodubtsev, Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR 1, 277 (1961). "Effect of Gamma-rays on Adsorption by Silica Gel of Complex Cobalt Compounds."
- a. Adsorption of cobalt amminochlorides from solution
237. Veselovsky, V. I., Proc. U. N. Intern. Conf. Peaceful Uses Atomic Energy, 1st, Geneva, 1955, 7, 599 (Pub. 1956). "Radiation-Chemical Processes in Inorganic Systems."
- a. H_2O_2 formation and decomposition
 - b. ZnO , iron oxide
 - c. Co^{60}
238. Veselovsky, V. I., N. B. Miller, and D. M. Shub, Symp. Radiation Chem., Moscow, 1955, (English Transl.) p 49. "Investigation of the Laws of Radiochemical Homogeneous and Heterogeneous Formation of Hydrogen Peroxide."
- b. ZnO suspension
 - c. Co^{60}

239. Veselovsky, V. I., and G. S. Tyurikov, Symp. Radiation Chem., Moscow, 1955 (English Transl.), p 61. "Investigation of the Laws of Radiochemical Homogeneous and Heterogeneous Decomposition of Hydrogen Peroxide."
- b. $\text{Fe}_2\text{O}_3/\text{Fe}$
 - c. Co^{60}
240. Veselovsky, V. I., Ts. I. Zalkind, N. B. Miller, and N. A. Aladzhalova, Symp. Radiation Chem., Moscow, 1955 (English Transl.), p 36. "Investigation of the Mechanism and Kinetics of Oxidation-Reduction Reactions in Aqueous Solutions under the Action of Radioactive Radiations."
- d. Includes the effect of Pt on Ce(IV) reduction by Co^{60} gamma-rays.
241. Weisz, P. B., and E. W. Swegler, J. Chem. Phys. 23, 1567 (1955). "Catalytic Activity Induced by Neutron Irradiation of Inert Silica."
- a. Isomerization of n-hexene-1, cracking of isopropylbenzene
 - c. Reactor
242. Wethington, J. A., and E. H. Taylor, Chemistry Division Quarterly Progress Report, Period Ending March 31, 1951, ORNL-1053, p 131. "Effect of Radiation on Heterogeneous Catalysts."
- a. C_2H_4 hydrogenation
 - b. ZnO
 - c. Co^{60}
 - d. See reference 211
243. Wethington, J. A., and E. H. Taylor, Chemistry Division Quarterly Progress Report, Period Ending June 30, 1951, ORNL-1116, p 75. "Radiation Effects on Heterogeneous Catalysts."
- d. See reference 242

244. Wethington, J. A., and E. H. Taylor, Chemistry Division Quarterly Progress Report, Period Ending Sept. 30, 1951, ORNL-1153, p 76.
"Effect of Radiation on Heterogeneous Catalysts."
d. See reference 242
245. Wolkenstein, Th., Discussions Faraday Soc. 31, 209 (1961). "Effect of Ionizing Radiation on the Adsorptive and Catalytic Properties of Semiconductors."
d. Electronic theory
246. Wolkenstein, Th., Kinetika i Kataliz 2, 481 (1961). "Effects of Ionizing Radiation on the Adsorptive and Catalytic Parameters of Semiconductors."
d. Electronic theory, similar to reference 245
247. Worrall, R., and A. Charlesby, Intern. J. Appl. Radiation Isotopes 4, 84 (1958). "Effect of Additives on the Radiation Induced Polymerization of Iso-butene."
b. ZnO, CaO, MgO, aerosil, NaHCO₃, carbon black, polyethylene powder
c. Co⁶⁰, 2-Mev electrons
248. Worrall, R., and S. H. Pinner, J. Polymer Sci. 34, 229 (1959). "Heterophase Radiation Polymerization of Isobutene and Methyl Methacrylate."
d. See reference 247
249. Yamashina, T., and H. E. Farnsworth, "Catalytic Activity of Cu-Ni Alloys as a Function of Argon-Ion Bombardment Current and Annealing," Paper presented at the 142nd National Meeting of the American Chemical Society, Atlantic City, Sept. 1962.
a. C₂H₄ hydrogenation
250. Yumato, T., H. C. Lin, and T. Matsuda, Nagoya Kogyo Gijutsu Shikensho Hokoku 11, No. 2-10, 114 (1962). "Radiolysis of Aqueous Solutions of Benzene in the Presence of Anions, Metals and Metallic Oxides."

251. British Patent 902,866, Kurashiki Rayon Co. Ltd., Aug. 9, 1962.
 "Carbon Catalysts and their use in the Preparation of Vinyl Esters."
 a. Vinylation of carboxylic acids or HCl with C_2H_2 ;
 C_2H_2 adsorption
 c. Co^{60} , electrons
252. Brookhaven National Laboratory, Progress Report, Nuclear Engineering Department, Jan. 1 - April 30, 1962, BNL-731, p 49. "Radiation Processing."
 a. Radiolysis of adsorbed NH_3 , polymerization of C_2H_4
 b. Alumina, Linde 13X molecular sieve
 c. Co^{60}
 d. See references 40, 41, 117
253. Charman, H. B., and R. M. Dell, Trans. Faraday Soc. 59, Pt 2, 470 (1963). "Chemisorption on Metal Oxides, Neutron-Irradiated Nickel Oxide and Magnesium Oxide."
 a. Chemisorption of H_2 , O_2 ; decomposition of N_2O
 c. Reactor (fast neutrons shown to be responsible for the observed effects)
 d. See reference 46
254. Gromov, V. V., and V. I. Spitsyn, Radiokhimiya 4, 532 (1962). "Adsorption of Some Organic Pigments from Aqueous Solutions by $BaSO_4$ Precipitates of High Radioactivity."
 a. Adsorption of methylene blue, acid orange
 c. Incorporated S^{35}
 d. See references 76, 192, 193
255. Guczi, L., and P. Tetenyi, Magy. Tud. Akad., Kem. Tud. Oszt. Kozlemeny. 18, 585 (1962). "Effect of Radioactive Radiation on the Adsorptive and Catalytic Properties of Solid Substances."
 d. Review

256. Kohn, H. W., and E. H. Taylor, J. Catalysis 2, 32 (1963). "The Effect of Ionizing Radiations on Catalytic Activity. Hydrogenation and Isotopic Exchange on Inorganic Solids."
- C_2H_4 hydrogenation, H_2-D_2 exchange
 - ZnO , ThO_2 , $BaTiO_3$, MgO , V_2O_3 , $KAlSi_3O_8$, $CaSiO_3$, LiH , NaH , BaH_2 , CaH_2 , TiO_2 , Al_2O_3 , SiO_2 , $Al_2O_3-SiO_2$
 - Co^{60} , reactor, X ray
257. Kramer, H., J. Pruzansky, and M. Steinberg, J. Appl. Radiation Isotopes 13, 641 (1962); BNL-6016, Feb. 1962. "Formation of Hydrazine from the Radiolysis of Ammonia in the Presence of Mineral Solids."
- Linde 5A and 13X molecular sieves, Al_2O_3 , C, $Na_2SiO_3 \cdot 5H_2O$, UO_2 , UO_3 , U_3O_8 , diatomaceous earth
 - Co^{60} , reactor, fission products
258. McFarling, J. L., and J. E. Kircher, "Experiments on Enhanced Catalytic Activity from Internal Irradiation of Catalysts," BMI-1620, Feb. 1963.
- Cyclohexanol dehydration
 - $MgSO_4-CaCl_2$ containing C or Al_2O_3 coated UO_2 microspheres
 - Fission products
 - See references 141-145
259. Mihail, R., and J. Hersovici, Proc. U. N. Intern. Conf. Peaceful Uses At. Energy, 2nd, Geneva, 1958 29, 317 (Pub. 1959). "Acceleration of Radical Reactions with Ionizing Radiation: Synthesis of Hydrocyanic Acid from Methane and Ammonia."
- Pt/asbestos
 - Co^{60} , 80 kv x rays

260. Topchiev, A. V., I. T. Aladiev, and P. S. Savitsky, Proc. U. N. Intern. Conf. Peaceful Uses At. Energy, 2nd, Geneva, 1958 19, 61 (Pub. 1959). "Applications of Radioisotopes."
d. Review including brief section on catalytic processes
261. U.S.S.R. Patent 148,031, V. I. Yakovlev, G. M. Panchenkov, L. L. Kozlov, Yu. M. Zhorov, and D. A. Kuzovkin, June 21, 1962. "Increasing Catalytic Activity of Aluminosilicate Catalysts."
c. Gamma, protons
d. See reference 155
262. U. S. Patent 3,051,737, E. J. Gibson (to Council of Scientific and Industrial Research) July 18, 1958. "Increasing the Activity of Iron Oxide Catalysts by Ionizing Radiation."
a. Fischer-Tropsch synthesis
c. Co⁶⁰, electrons
d. See references 50 and 72
263. Vladimirova, V. I., G. M. Zhabrova, B. M. Kadenatsi, V. B. Kazanskii, and G. B. Pariiskii, Dokl. Akad. Nauk SSSR 148, 101 (1963). "Joint Action of Radiation and Oxide Catalysts on the Dehydrogenation of Cyclohexane."
b. SiO₂, Al₂O₃, MgO, ZrO₂, ZnO, NiO, aluminosilicate
c. Co⁶⁰, 800-kev electrons
264. Yamashina, T., and H. E. Farnsworth, Ind. Eng. Chem. Prod. Res. Develop. 2, 34 (1963). "Catalytic Activity of Copper-Nickel Alloys as a Function of Argon-Ion Bombardment Current and Annealing."
a. C₂H₄ hydrogenation
d. See reference 249

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