

DAFTAR PUSTAKA

- Adam, F., Osman, H., and Hello, K.M., 2009, The immobilization of 3-(chloropropyl)triethoxysilane onto Silica by a Simple One-pot Synthesis, *J. Colloid Interface Sci.*, 331, 143–147.
- Alonso, D.M., Granados, M.L., Mariscal, R., and Douhal, A., 2009, Polarity of The Acid Chain of Esters and Transesterification Activity of Acid Catalysts, *J. Catal.*, 262, 18–26.
- Ambrozewicz, D., Ciesielczyk, F., Nowacka, M., Karasiewicz, J., Piasecki, A., Maclejewski, H., and Jasionowski, T., 2013, Fluoroalkylsilane versus Alkylsilane as Hydrophobic Agents for Silica and Silicates, *J. Nanomater.*, 2013, 1-14.
- An, S., Sun, Y., Song, D., Zhang, Q., Guo, Y., and Shang, Q., 2016, Arenesulfonic Acid-functionalized Alkyl-bridged Organosilica Hollow Nanospheres for Selective Esterification of Glycerol with Lauric Acid to Glycerol Mono- and Dilaurate, *J. Catal.*, 342, 40–54.
- Artyushkova, K., Kiefer, B., Halevi, B., Knop-Gericke, A., Schlogl, R., and Atanassov, P., 2013, Density Functional Theory Calculations of XPS Binding Energy Shift for Nitrogen-containing Graphene-like Structures, *Chem. Commun.*, 49, 2539–2541.
- Benak, K.R., Dominguez, L., Economy, J., and Mangun, C.L., 2002, Sulfonation of Pyropolymeric Fibers Derived from Phenol-Formaldehyde Resins, *Carbon N. Y.*, 40, 2323–2332.
- Berbar, Y., Hammache, Z.E., Bensaadi, S., Soukeur, R., Amara, M., and der Bruggen, B.V., 2019, Effect of Functionalized Silica Nanoparticles on Sulfonated Polyethersulfone Ion Exchange Membrane for Removal of Lead and Cadmium Ions from Aqueous Solutions, *J. Water Process Eng.*, 32, 100953.
- Berrios, M., Siles, J., Martí'n, M.A., and Martí'n, A., 2007, A Kinetic Study of The Esterification of Free Fatty Acids (FFA) in Sunflower Oil, *Fuel*, 86, 2383–2388.
- Bhagiyalakshmi, M., Priya, S.V., Mabel, J.H., Palanichamy, M., and Murugesan, V., 2008, Effect of Hydrophobic and Hydrophilic Properties of Solid Acid Catalysts on The Esterification of Maleic Anhydride with Ethanol, *Catal. Commun.*, 9, 2007–2012.
- Blanco-Brieva, G., Campos-Martin, J.M., De Pilar Frutos, M., and Fierro, J.L.G., 2008, Preparation, Characterization, and Acidity Evaluation of Perfluorosulfonic Acid-Functionalized Silica Catalysts, *Ind. Eng. Chem. Res.*, 47, 8005–8010.
- Cannilla, C., Bonura, G., Costa, F., and Frusteri, F., 2018, Biofuels Production by Esterification of Oleic Acid with Ethanol using A Membrane Assisted



Reactor in Vapour Permeation Configuration, *Appl. Catal. A Gen.*, 566, 121–129.

Chen, C., Shi, S., Wang, M., Ma, H., Zhou, L., and Xu, J., 2014, Superhydrophobic SiO₂-based Nanocomposite being Modified with Organic Groups as Catalyst for Selective Oxidation of Ethylbenzene, *J. Mater. Chem. C*, 2, 8126–8134.

Chen, J., Chen, J., Zhang, X., Gao, J., and Yang, Q., 2016a, Efficient and Stable PS-SO₃H/SiO₂ Hollow Nanospheres with Tunable Surface Properties for Acid Catalyzed Reactions, *Appl. Catal. A Gen.*, 516, 1–8.

Chen, S.S., Yu, I.K.M., Cho, D.W., Song, H., Tsang, D.C.W., Tessonner, J.P., Ok, Y.S., and Poon, C.S., 2018, Selective Glucose Isomerization to Fructose via a Nitrogen-doped Solid Base Catalyst Derived from Spent Coffee Grounds, *ACS Sustain. Chem. Eng.*, 6, 16113–16120.

Chong, A.S.M., and Zhao, X.S., 2003, Functionalization of SBA-15 with APTES and Characterization of Functionalized Materials, *J. Phys. Chem. B*, 107, 12650–12657.

Chonkaew, W., Minghvanish, W., Kungliean, U., Rochanawipart, N., and Brostow, W., 2011, Vulcanization Characteristics and Dynamic Mechanical Behavior of Natural Rubber Reinforced with Silane Modified Silica, *J. Nanosci. Nanotechnol.*, 11, 2018–2024.

Corma, A., Garcia, H., Iborra, S., and Primo, J., 1989, Modified Faujasite Zeolites as Catalysts in Organic Reactions: Esterification of Carboxylic Acids in The Presence of HY Zeolites, *J. Catal.*, 120, 78–87.

Da'na, E., 2017, Adsorption of Heavy Metals on Functionalized-mesoporous Silica: A Review, *Microporous Mesoporous Mater.*, 247, 145–157.

Dacquin, J.P., Cross, H.E., Brown, D.R., Düren, T., Williams, J.J., Lee, A.F., and Wilson, K., 2010, Interdependent Lateral Interactions, Hydrophobicity and Acid Strength and Their Influence on The Catalytic Activity of Nanoporous Sulfonic Acid Silicas, *Green Chem.*, 12, 1383–1391.

Diagboya, P.N.E. and Dikio, E.D., 2018, Silica-based Mesoporous Materials; Emerging Designer Adsorbents for Aqueous Pollutants Removal and Water Treatment, *Microporous Mesoporous Mater.*, 266, 252–267.

Dou, Y., Zhang, H., Zhou, A., Yang, F., Shu, L., She, Y., and Li, J.R., 2018, Highly Efficient Catalytic Esterification in an -SO₃H-Functionalized Cr(III)-MOF, *Ind. Eng. Chem. Res.*, 57, 8388–8395.

El-Debs, R., Cadoux, F., Bois, L., Bonhommé, A., Randon, J., Dugas, V., and Demesmay, C., 2015, Synthesis and Surface Reactivity of Vinylized Macroporous Silica Monoliths: One-Pot Hybrid versus Postsynthesis Grafting Strategies, *Langmuir*, 31, 11649–11658.



- Elsayed, I., Mashaly, M., Eltawee, F., Jackson, M.A., and Hassan, E.B., 2018, Dehydration of Glucose to 5-hydroxymethylfurfural by A Core-shell $\text{Fe}_3\text{O}_4@\text{SiO}_2\text{-SO}_3\text{H}$ Magnetic Nanoparticle Catalyst, *Fuel*, 221, 407–416.
- Fashandi, M., Karamikamkar, S., Leung, S.N., Naguib, H.E., Hong, J., Liang, B., and Park, C.B., 2022, Synthesis, Structures and Properties of Hydrophobic Alkyltrimethoxysilane-Polyvinyltrimethoxysilane Hybrid Aerogels with Different Alkyl Chain Lengths, *J. Colloid Interface Sci.*, 608, 720–734.
- Fernandes, D.R., Rocha, A.S., Mai, E.F., Mota, C.J.A., and Teixeira Da Silva, V., 2012, Levulinic Acid Esterification with Ethanol to Ethyl Levulinate Production over Solid Acid Catalysts, *Appl. Catal. A Gen.*, 425–426, 199–204.
- Gabrielli, L., Russo, L., Poveda, A., Jones, J.R., Nicotra, F., Jiménez-Barbero, J., and Cipolla, L., 2013, Epoxide Opening versus Silica Condensation during Sol-Gel Hybrid Biomaterial Synthesis, *Chem. - A Eur. J.*, 19, 7856–7864.
- Gao, P., Liang, Z., Zhao, Z., Wang, W., Yang, C., Hu, B., and Cui, F., 2019, Enhanced Adsorption of Steroid Estrogens by One-Pot Synthesized Phenyl-Modified Mesoporous Silica: Dependence on Phenyl-Organosilane Precursors and pH Condition, *Chemosphere*, 234, 438–449.
- García, N., Benito, E., Guzmán, J., and Tiemblo, P., 2007, Use of p-toluenesulfonic Acid for The Controlled Grafting of Alkoxy silanes onto Silanol Containing Surfaces: Preparation of Tunable Hydrophilic, Hydrophobic, and Super-Hydrophobic Silica, *J. Am. Chem. Soc.*, 129, 5052–5060.
- Gaurav, A., Dumas, S., Mai, C.T.Q., and Ng, F.T.T., 2019, A Kinetic Model for A Single Step Biodiesel Production from A High Free Fatty Acid (FFA) Biodiesel Feedstock over A Solid Heteropolyacid Catalyst, *Green Energy Environ.*, 4, 328–341.
- González, M.D., Salagre, P., Taboada, E., Llorca, J., Molins, E., and Cesteros, Y., 2013, Sulfonic Acid-Functionalized Aerogels as High Resistant to Deactivation Catalysts for The Etherification of Glycerol with Isobutene, *Appl. Catal. B Environ.*, 136–137, 287–293.
- Gupta, G., Pathak, S.S., and Khanna, A.S., 2012, Anticorrosion Performance of Eco-Friendly Silane Primer for Coil Coating Applications, *Prog. Org. Coatings*, 74, 106–114.
- Gupta, P., and Paul, S., 2014, Solid acids : Green alternatives for Acid Catalysis, *Catal. Today*, 236, 153–170.
- Gurav, J.L., Rao, A.V., Rao, A.P., Nadargi, D.Y., and Bhagat, S.D., 2009, Physical Properties of Sodium Silicate Based Silica Aerogels Prepared by Single Step Sol-Gel Process Dried at Ambient Pressure, *J. Alloys Compd.*, 476, 397–402.
- Han, X., Zhu, G., Ding, Y., Miao, Y., Wang, K., Zhang, H., Wang, Y., and Liu, S. Bin, 2019, Selective Catalytic Synthesis of Glycerol Monolaurate over



Silica Gel-Based Sulfonic Acid Functionalized Ionic Liquid Catalysts,
Chem. Eng. J., 359, 733–745.

- Hayes, D.J., Fitzpatrick, S., Hayes, M.H.B., and Ross, J.R.H., 2006, *The Biofine Process - Production of Levulinic Acid, Furfural, and Formic Acid from Lignocellulosic Feedstocks*, Wiley-VCH, Weinheim.
- Hello, K.M., Hasan, H.R., Sauodi, M.H., and Morgen, P., 2014, Cellulose Hydrolysis over Silica Modified with Chlorosulphonic Acid in One Pot Synthesis, *Appl. Catal. A Gen.*, 475, 226–234.
- Heo, J.H., Lee, J.W., Lee, B., Cho, H.H., Lim, B., and Lee, J.H., 2017, Chemical Effects of Organo-Silanized SiO₂ Nanofillers on Epoxy Adhesives, *J. Ind. Eng. Chem.*, 54, 184–189.
- Jamal, Y., and Boulanger, B.O., 2010, Separation of Oleic Acid from Soybean Oil using Mixed-bed Resins, *J. Chem. Eng. Data*, 55, 2405–2409.
- Joshi, H., Moser, B.R., Toler, J., Smith, W.F., and Walker, T., 2011, Ethyl Levulinate: A Potential Bio-Based Diluent For Biodiesel which Improves Cold Flow Properties, *Biomass and Bioenergy*, 35, 3262–3266.
- Kang, K.S., 2012, The Cause of Highly Efficient Lead Removal with Silica Spheres Modifying The Surface by A Base Catalyst, *Ind. Eng. Chem. Res.*, 51, 4101–4104.
- Khan, Z., Javed, F., Shamair, Z., Hafeez, A., Fazal, T., Aslam, A., Zimmerman, W.B., and Rehman, F., 2021, Current Developments in Esterification Reaction: A Review on Process and Parameters, *J. Ind. Eng. Chem.*, 103, 80–101.
- Kim, K.S., and Winograd, N., 1975, X-Ray Photoelectron Spectroscopic Binding Energy Shifts due to Matrix in Alloys and Small Supported Metal Particles, *Chem. Phys. Lett.*, 30, 91–95.
- Kong, A., Wang, P., Zhang, H., Yang, F., Huang, S., and Shan, Y., 2012, Applied Catalysis A : General One-pot Fabrication of Magnetically Recoverable Acid Nanocatalyst, Heteropolyacids/Chitosan/Fe₃O₄, and Its Catalytic Performance, *App. Catal. A, Gen.*, 417–418, 183–189.
- Kong, P.S., Cognet, P., Pérès, Y., Esvan, J., Daud, W.M.A.W., and Aroua, M.K., 2018, Development of a Novel Hydrophobic ZrO₂-SiO₂ Based Acid Catalyst for Catalytic Esterification of Glycerol with Oleic Acid, *Ind. Eng. Chem. Res.*, 57, 9386–9399.
- Kuwahara, Y., Kaburagi, W., Nemoto, K., and Fujitani, T., 2014, Esterification of Levulinic Acid with Ethanol over Sulfated Si-Doped ZrO₂ Solid Acid Catalyst: Study of The Structure-Activity Relationships, *Appl. Catal. A Gen.*, 476, 186–196.
- Lazar, A., George, S.C., Jithesh, P.R., Vinod, C.P., and Singh, A.P., 2016, Correlating The Role of Hydrophilic/Hydrophobic Nature of Rh(I) and



Ru(II) Supported Organosilica/Silica Catalysts in Organotransformation Reactions, *Appl. Catal. A Gen.*, 513, 138–146.

Lazghab, M., Saleh, K., and Guigon, P., 2010, Functionalisation of Porous Silica Powders in A Fluidised-Bed Reactor with Glycidoxypolytrimethoxysilane (GPTMS) and Aminopropyltriethoxysilane (APTES), *Chem. Eng. Res. Des.*, 88, 686–692.

Leung, D.Y.C., Wu, X., and Leung, M.K.H., 2010, A Review on Biodiesel Production using Catalyzed Transesterification, *Appl. Energy*, 87, 1083–1095.

Li, N., Wang, Q., Ullah, S., Zheng, X.C., Peng, Z.K., and Zheng, G.P., 2019, Esterification of Levulinic Acid in The Production of Fuel Additives Catalyzed by Porous Sulfonated Carbon Derived from Pine Needle, *Catal. Commun.*, 129, 105755.

Lindsay, D., Sherrington, D., Greig, J., and Hancock, R., 1987, Novel Chelating Resins with Remarkably High Selectivities for Copper(II) over Zinc(II) Ions, *J. Chem. Soc. Chem. Commun.*, 396, 1270–1272.

Liu, R.L., Gao, X.Y., An, L., Ma, J., Zhang J.F., and Zhang, Z.Q., 2015, Fabrication of Magnetic Carbonaceous Solid Acids from Banana Peel for The Esterification of Oleic Acid, *RSC Adv.*, 5, 93858–93866.

Liu, Y., Huo, P., Ren, J., and Wang, G., 2017, Organic–inorganic Hybrid Proton-Conducting Electrolyte Membranes based on Sulfonated Poly(Arylene Ether Sulfone) and SiO₂–SO₃H Network for Fuel Cells, *High Perform. Polym.*, 29, 1037–1048.

Liu, Y., Lotero, E., and Goodwin, J.G., 2006, Effect of Carbon Chain Length on Esterification of Carboxylic Acids with Methanol using Acid Catalysis, *J. Catal.*, 243, 221–228.

Long, W., and Jones, C.W., 2011, Hybrid Sulfonic Acid Catalysts Based on Silica-Supported Poly(Styrene Sulfonic Acid) Brush Materials and Their Application in Ester Hydrolysis, *ACS Catal.*, 1, 674–681.

de Luca, M.A., Martinelli, M., and Barbieri, C.C.T., 2009, Hybrid Films Synthesised from Epoxidised Castor Oil, Γ -Glycidoxypolytrimethoxysilane and Tetraethoxysilane, *Prog. Org. Coatings*, 65, 375–380.

Lucena, I.L., Saboya, R.M.A., Oliveira, J.F.G., Rodrigues, M.L., Torres, A.E.B., Cavalcante, C.L., Parente, E.J.S., Silva, G.F., and Fernandes, F.A.N., 2011, Oleic Acid Esterification with Ethanol under Continuous Water Removal Conditions, *Fuel*, 90, 902–904.

Ma, J., Yang, X., Nie, Y., and Wang, B., 2018, The Influence of A Hydrophobic Carrier, Reactant and Product During H₂O Adsorption on Pd Surface for The Oxidative Esterification of Methacrolein to Methyl Methacrylate, *Phys. Chem. Chem. Phys.*, 20, 9965–9974.



- Mahmoud, H.R., 2019, Bismuth Silicate ($\text{Bi}_4\text{Si}_3\text{O}_{12}$ and Bi_2SiO_5) Prepared by Ultrasonic-Assisted Hydrothermal Method as Novel Catalysts for Biodiesel Production via Oleic Acid Esterification with Methanol, *Fuel*, 256, 115979.
- Marchetti, J.M., and Errazu, A.F., 2008, Esterification of Free Fatty Acids using Sulfuric Acid as Catalyst in The Presence of Triglycerides, *Biomass Bioenergy*, 32, 892–895.
- Margelefsky, E.L., Bendjériou, A., Zeidan, R.K., Dufaud, V., and Davis, M.E., 2008, Nanoscale Organization of Thiol and Arylsulfonic Acid on Silica Leads to A Highly Active and Selective Bifunctional, Heterogeneous Catalyst, *J. Am. Chem. Soc.*, 130, 13442–13449.
- Melero, J.A., Bautista, L.F., Morales, G., Iglesias, J., and Sánchez-Vázquez, R., 2015, Acid-catalyzed Production of Biodiesel over Arenesulfonic SBA-15: Insights into The Role of Water in The Reaction Network, *Renew. Energy*, 75, 425–432.
- Mobaraki, A., Movassagh, B., and Karimi, B., 2014, Hydrophobicity-enhanced Magnetic Solid Sulfonic Acid: A Simple Approach to Improve The Mass Transfer of Reaction Partners on The Surface of The Heterogeneous Catalyst in Water-Generating Reactions, *Appl. Catal. A Gen.*, 472, 123–133.
- Mohino, F., Díaz, I., Pérez-Pariente, J., and Sastre, E., 2002, Synthesis, Characterisation and Catalytic Activity of SO_3H -phenyl-MCM-41 Materials, *Stud. Surf. Sci. Catal.*, 142 B, 1275–1282.
- Morel, A.L., Nikitenko, S.I., Gionnet, K., Wattiaux, A., Lai-Kee-Him, J., Labrugere, C., Chevalier, B., Deleris, G., Petibois, C., Brisson, A., and Simonoff, M., 2008, Sonochemical Approach to The Synthesis of $\text{Fe}_3\text{O}_4 @ \text{SiO}_2$ Core-Shell Nanoparticles with Tunable Properties, *ACS Nano*, 2, 847–856.
- Newman, J.A., Schmitt, P.D., Toth, S.J., Deng, F., Zhang, S., and Simpson, G.J., 2015, Parts per Million Powder X-ray Diffraction, *Anal. Chem.*, 87, 10950–10955.
- Nhavene, E.P.F., da Silva, W.M., Junior, R.R.T., Gastelois, P.L., Venâncio, T., Nascimento, R., Baptista, R.J.C., Machado, C.R., Macedo, W.A.A., and Sousa, E.M.B., 2018, Chitosan Grafted into Mesoporous Silica Nanoparticles as Benznidazol Carrier for Chagas Diseases Treatment, *Microporous Mesoporous Mater.*, 272, 265–275.
- Niu, S., Ning, Y., Lu, C., Han, K., Yu, H., and Zhou, Y., 2018, Esterification of Oleic Acid to Produce Biodiesel Catalyzed by Sulfonated Activated Carbon from Bamboo, *Energy Convers. Manag.*, 163, 59–65.
- Nuryono, N., Qomariyah, A., Kim, W., Otomo, R., Rusdiarso, B., and Kamiya, Y., 2019a, Octyl and Propylsulfonic Acid Co-fixed $\text{Fe}_3\text{O}_4 @ \text{SiO}_2$ as A Magnetically Separable, Highly Active and Reusable Solid Acid Catalyst in Water, *Mol. Catal.*, 475, 1–9.



- Okoye-Chine, C.G., Moyo, M., and Hildebrandt, D., 2021a, Fischer-Tropsch Synthesis: The Effect of Hydrophobicity on Silica-supported Iron Catalysts, *J. Ind. Eng. Chem.*, 97, 426–433.
- Okoye-Chine, C.G., Moyo, M., and Hildebrandt, D., 2021b, The Effect of Hydrophobicity on SiO₂-supported Co Catalysts in Fischer-Tropsch Synthesis, *Fuel*, 296, 120667.
- de Oliveira, F.M., Segatelli, M.G., and Tarley, C.R.T., 2016, Hybrid Molecularly Imprinted Poly(methacrylic acid-TRIM)-Silica Chemically Modified with (3-glycidyloxypropyl)trimethoxysilane for The Extraction of Folic Acid in Aqueous Medium, *Mater. Sci. Eng. C*, 59, 643–651.
- Palla-Rubio, B., Araújo-Gomes, N., Fernández-Gutiérrez, M., Rojo, L., Suay, J., Gurruchaga, M., and Goñi, I., 2019, Synthesis and Characterization of Silica-Chitosan Hybrid Materials as Antibacterial Coatings for Titanium Implants, *Carbohydr. Polym.*, 203, 331–341.
- Panjwani, B., and Sinha, S.K., 2012, Tribology and Hydrophobicity of A Biocompatible GPTMS/PFPE Coating on Ti₆Al₄V Surfaces, *J. Mech. Behav. Biomed. Mater.*, 15, 103–111.
- Parale, V.G., Kim, T., Lee, K.Y., Phadtare, V.D., Dhavale, R.P., Jung, H.N.R., and Park, H.H., 2020, Hydrophobic TiO₂-SiO₂ Composite Aerogels Synthesized Via In Situ Epoxy-Ring Opening Polymerization And Sol-Gel Process For Enhanced Degradation Activity, *Ceram. Int.*, 46, 4939–4946.
- Park, J.Y., Kim, D.K., and Lee, J.S., 2010, Esterification of Free Fatty Acids using Water-tolerable Amberlyst as a Heterogeneous Catalyst, *Bioresour. Technol.*, 101, S62–S65.
- Peng, J., Yao, Y., Zhang, X., Li, C., and Yang, Q., 2014, Superhydrophobic Mesoporous Silica Nanospheres Achieved via A High Level of Organo-functionalization, *Chem. Commun.*, 50, 10830–10833.
- Pirez, C., Lee, A.F., Jones, C., and Wilson, K., 2014, Can Surface Energy Measurements Predict The Impact of Catalyst Hydrophobicity upon Fatty Acid Esterification over Sulfonic Acid Functionalised Periodic Mesoporous Organosilicas?, *Catal. Today*, 234, 167–173.
- Popova, M., Shestakova, P., Lazarova, H., Dimitrov, M., Kovacheva, D., Szegedi, A., Mali, G., Dasireddy, V., Likozar, B., Wilde, N., and Gläser, R., 2018, Efficient Solid Acid Catalysts based on Sulfated Tin Oxides for Liquid Phase Esterification of Levulinic Acid with Ethanol, *Appl. Catal. A Gen.*, 560, 119–131.
- Prinsen, P., Luque, R., and González-Arellano, C., 2018, Zeolite Catalyzed Palmitic Acid Esterification, *Microporous Mesoporous Mater.*, 262, 133–139.
- Purwanto, M., Atmaja, L., Mohamed, M.A., Salleh, M.T., Jaafar, J., Ismail, A.F., Santoso, M., and Widiastuti, N., 2016, Biopolymer-based Electrolyte



Membranes from Chitosan Incorporated with Montmorillonite-Crosslinked GPTMS for Direct Methanol Fuel Cells, *RSC Adv.*, 6, 2314–2322.

Rahman, M.A., Azad, M.A.K., Ahsan, S., Islam, S., Motin, M.A., and Asadullah, M., 2006, Measurement of Brönsted Acidity of Silica-alumina Solid Catalyst by Base Exchange Method, *J. Surf. Sci. Technol.*, 22, 25–33.

Ramezani, M., Vaezi, M.R., and Kazemzadeh, A., 2015, The Influence of The Hydrophobic Agent, Catalyst, Solvent and Water Content on The Wetting Properties of The Silica Films Prepared by One-step Sol-gel Method, *Appl. Surf. Sci.*, 326, 99–106.

Reyes-Peces, M. V., Pérez-Moreno, A., De-Los-santos, D.M., Mesa-Díaz, M.D.M., Pinaglia-Tobaruela, G., Vilches-Pérez, J.I., Fernández-Montesinos, R., Salido, M., de la Rosa-Fox, N., and Piñero, M., 2020, Chitosan-GPTMS-silica Hybrid Mesoporous Aerogels for Bone Tissue Engineering, *Polymers (Basel)*, 12, 1–24.

Satyarthi, J.K., Radhakrishnan, S., and Srinivas, D., 2011, Factors Influencing The Kinetics of Esterification of Fatty Acids over Solid Acid Catalysts, *Energy and Fuels*, 25, 4106–4112.

Satyarthi, J.K., Srinivas, D., and Ratnasamy, P., 2010, Influence of Surface Hydrophobicity on The Esterification of Fatty Acids over Solid Catalysts, *Energy and Fuels*, 24, 2154–2161.

Schildhauer, T.J., Hoek, I., Kapteijn, F., and Moulijn, J.A., 2009, Zeolite BEA Catalysed Esterification of Hexanoic Acid with 1-Octanol: Kinetics, Side Reactions and The Role of Water, *Appl. Catal. A Gen.*, 358, 141–145.

Shajesh, P., Smitha, S., Aravind, P.R., and Warrier, K.G.K., 2009, Synthesis, Structure and Properties of Cross-linked R(SiO_{1.5})/SiO₂ (R = 3-glycidoxypipropyl) Porous Organic Inorganic Hybrid Networks Dried at Ambient Pressure, *J. Colloid Interface Sci.*, 336, 691–697.

Shao, Z., Wu, G., Cheng, X., and Zhang, Y., 2012, Rapid Synthesis of Amine Cross-Linked Epoxy and Methyl Co-Modified Silica Aerogels By Ambient Pressure Drying, *J. Non. Cryst. Solids*, 358, 2612–2615.

Shard, A.G., 2014, Detection Limits in XPS for more than 6000 Binary Systems using Al and Mg K α X-rays, *Surf. Interface Anal.*, 46, 175–185.

Sheldon, R.A., and Downing, R.S., 1999, Heterogeneous Catalytic Transformations for Environmentally Friendly Production, *Appl. Catal. A*, 189, 163–183.

Shokoohi, S., Arefazar, A., and Khosrokhavar, R., 2008, Silane Coupling Agents in Polymer-based Reinforced Composites: A Review, *J. Reinf. Plast. Compos.*, 27, 473–485.

Sierra, I., and Pérez-Quintanilla, D., 2013, Heavy Metal Complexation on Hybrid Mesoporous Silicas: An Approach to Analytical Applications, *Chem. Soc. Rev.*, 42, 3792–3807.



- Szeląg, H., and Sadecka, E., 2009, Influence of Sodium Dodecyl Sulfate Presence on Esterification of Propylene Glycol with Lauric Acid, *Ind. Eng. Chem. Res.*, 48, 8313–8319.
- Tao, J., Feng, Z., Zhao, J., Rizwan Younis, M., Lu, W., Chen, D., Weng, L., Su, X., Teng, Z., and Wang, L., 2022, Self-transformation Synthesis of Hierarchically Porous Benzene-Bridged Organosilica Nanoparticles for Efficient Drug Delivery, *J. Colloid Interface Sci.*, 608, 1393–1400.
- Tao, J.G., Pan, J.S., Huan, C.H.A., Zhang, Z., Chai, J.W., and Wang, S.J., 2008, Origin of XPS Binding Energy Shifts in Ni Clusters And Atoms on Rutile TiO₂ Surfaces, *Surf. Sci.*, 602, 2769–2773.
- Tian, C., Zhu, X., Chai, S.H., Wu, Z., Binder, A., Brown, S., Li, L., Luo, H., Guo, Y., and Dai, S., 2014, Three-phase Catalytic System of H₂O, Ionic Liquid, and VOPO 4-SiO₂ Solid Acid for Conversion of Fructose to 5-Hydroxymethylfurfural, *ChemSusChem*, 7, 1703–1709.
- Tian, X., Zhang, L.L., Bai, P., and Zhao, X.S., 2011, Sulfonic-acid-functionalized Porous Benzene Phenol Polymer and Carbon for Catalytic Esterification of Methanol with Acetic Acid, *Catal. Today*, 166, 53–59.
- Trinh, B.M., and Mekonnen, T., 2018, Hydrophobic Esterification of Cellulose Nanocrystals for Epoxy Reinforcement, *Polymer*, 155, 64–74.
- Tsai, C., Chang, W., Saikia, D., Wu, C., and Kao, H., 2015, Functionalization of Cubic Mesoporous Silica SBA-16 with Carboxylic Acid via One-Pot Synthesis Route for Effective Removal of Cationic Dyes, *J. Hazard. Mater.*, 309, 234–248.
- Vicente, G., Martínez, M., and Aracil, J., 2004, Integrated Biodiesel Production: A Comparison of Different Homogeneous Catalysts Systems, *Bioresour. Technol.*, 92, 297–305.
- Vreugdenhil, A.J., Gelling, V.J., Woods, M.E., Schmelz, J.R., and Enderson, B.P., 2008, The Role of Crosslinkers in Epoxy-Amine Crosslinked Silicon Sol-Gel Barrier Protection Coatings, *Thin Solid Films*, 517, 538–543.
- Wang, L., Wang, H., Liu, F., Zheng, A., Zhang, J., Sun, Q., Lewis, J.P., Zhu, L., Meng, X., and Xiao, F.S., 2014, Selective Catalytic Production of 5-Hydroxymethylfurfural from Glucose by Adjusting Catalyst Wettability, *ChemSusChem*, 7, 402–406.
- Watts, J.F., and Wolstenholme, J., 2003, An Introduction to Surface Analysis by XPS and AES, John Wiley & Sons, New York.
- Wu, L., Hu, X., Wang, S., Mahmudul Hasan, M.D., Jiang, S., Li, T., and Li, C.Z., 2018, Acid-treatment of Bio-oil in Methanol: The Distinct Catalytic Behaviours of A Mineral Acid Catalyst And A Solid Acid Catalyst, *Fuel*, 212, 412–421.
- Wu, Z., Chen, C., Wang, L., Wan, H., and Guan, G., 2016, Magnetic Material Grafted Poly(phosphotungstate-based acidic ionic liquid) As Efficient and



Recyclable Catalyst for Esterification of Oleic Acid, *Ind. Eng. Chem. Res.*, 55, 1833–1842.

Xiong, Y., Zhang, Z., Wang, X., Liu, B., and Lin, J., 2014, Hydrolysis of Cellulose in Ionic Liquids Catalyzed by A Magnetically-Recoverable Solid Acid Catalyst, *Chem. Eng. J.*, 235, 349–355.

Xuan, W., Hakkarainen, M., and Odelius, K., 2019, Levulinic Acid as a Versatile Building Block for Plasticizer Design, *ACS Sustain. Chem. Eng.*, 7, 12552–12562.

Yaakob, Z., Narayanan, B.N., Padikkaparambil, S., Unni K., S., and Akbar P., M., 2014, A review on The Oxidation Stability of Biodiesel, *Renew. Sustain. Energy Rev.*, 35, 136–153.

Yadav, G.D., and Yadav, A.R., 2014, Synthesis of Ethyl Levulinate as Fuel Additives using Heterogeneous Solid Superacidic Catalysts: Efficacy and Kinetic Modeling, *Chem. Eng. J.*, 243, 556–563.

Yan, L., Yao, Q., and Fu, Y., 2017, Conversion of Levulinic Acid and Alkyl Levulinates into Biofuels and High-Value Chemicals, *Green Chem.*, 19, 5527–5547.

Yong, W.Y.D., Zhang, Z., Cristobal, G., and Chin, W.S., 2014, One-pot Synthesis of Surface Functionalized Spherical Silica Particles, *Colloids Surf. A Physicochem. Eng. Asp.*, 460, 151–157.

Yoo, B.U., Han, M.H., Nersisyan, H.H., Yoon, J.H., Lee, K.J., and Lee, J.H., 2014, Self-templated Synthesis of Hollow Silica Microspheres using Na₂SiO₃ Precursor, *Microporous Mesoporous Mater.*, 190, 139–145.

Zainol, M.M., Amin, N.A.S., and Asmadi, M., 2019, Kinetics and Thermodynamic Analysis of Levulinic Acid Esterification using Lignin-Furfural Carbon Cryogel Catalyst, *Renew. Energy*, 130, 547–557.

Zelenák, V., Skřínska, M., Siperstein, F.R., and Patti, A., 2019, Phase Evolution during One-Pot Synthesis of Amine Modified Mesoporous Silica Materials: Preparation, Properties, Carbon Dioxide Adsorption, *Appl. Surf. Sci.*, 476, 886–896.

Zhao, Z.H., 2001, Studies on Esterification Reaction over Aluminophosphate and Silicoaluminophosphate Molecular Sieves, *J. Mol. Catal. A Chem.*, 168, 147–152.

Zhong, Y., Deng, Q., Yao, Q., Lu, C., Zhang, P., Li, H., Wang, J., Zeng, Z., Zou, J.J., Zou, J.J., and Deng, S., 2020, Functionalized Biochar with Superacidity and Hydrophobicity as a Highly Efficient Catalyst in the Synthesis of Renewable High-Density Fuels, *ACS Sustain. Chem. Eng.*, 8, 7785–7794.

Zhou, Y., Niu, S., and Li, J., 2016, Activity of The Carbon-based Heterogeneous Acid Catalyst Derived from Bamboo in Esterification of Oleic Acid with Ethanol, *Energy Convers. Manag.*, 114, 188–196.



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- Ziarani, G.M., Badiei, A., Hassanzadeh, M., and Mousavi, S., 2014, Synthesis of 1,8-dioxo-decahydroacridine Derivatives using Sulfonic Acid Functionalized Silica ($\text{SiO}_2\text{-Pr-SO}_3\text{H}$) under Solvent Free Conditions, *Arab. J. Chem.*, 7, 335–339.
- Zuo, D., Lane, J., Culy, D., Schultz, M., Pullar, A., and Waxman, M., 2013, Sulfonic Acid Functionalized Mesoporous SBA-15 Catalysts for Biodiesel Production, *Appl. Catal. B Environ.*, 129, 342–350.