08/14/2001

# **INDEX**

#### Alumina templates anodic, 169-170 Acetylene adsorption, selective, 117 processing anodic films, 170 Acoustic cavitation, nanostructured scanning electron microscopy (SEM) of catalysts, 19 porous, 171 Activated alumina schematic, 170 self-organized pore structure, 171 commercial, 93 commercial use, 80 Antimony nanowires, pore size distribution, 89 temperature-dependent resistivity, Activated carbon 197-198 adsorption of water vapor, 91 commercial use, 80 В effects of oxidation on water adsorption, equilibrium sorption of water vapor, 90-91 Ballistic transport, 191 fibers, 91-92 Band structures, nanowire interests in hydrogen storage by calculated subband energies as function of adsorption, 92 in-plane mass anisotropy, 188 manufacture and use, 88 carrier densities, 190-191 methane, 92 dispersion relation of electrons, 185 pore size distribution, 89 envelope wavefunction of electrons, 186 grid points transforming differential raw materials, 88-89 recent developments, 91-92 equation to difference equation, 187 infinitely long wire with circular cross tailoring pore structure for applications, section, 186 89-90 unique surface property, 90 one-dimensional systems, 185-188 Adsorbents, see Nanostructured adsorbents parameters determining electronic Adsorption properties, 186-187 semimetal-semiconductor transition in effect of adsorbate properties, 84-85 heat of, 83-84 semimetallic nanowires, 188-191 potential energies for, 81-83 subband energy, 187 properties of pillared clays, 120 theoretical modeling, 185-191 properties of zeolites, 99-100 Barium hexaaluminate, reverse threshold pressure in pore sizes and microemulsion, 13-14 shapes, 87 Bending properties, nanophase see also Nanostructured adsorbents ceramics, 158 Bernoulli effect, cavitational bubble Advanced catalysts hydrodynamic cavitation, 3 formation, 22 nanostructured materials, 2-3 **Bioceramics** Aerosol catalyst studies, 19 effect of surface properties, 146 Ag, see Silver on alumina inconsistency of efficacy, 146 Alumina orthopedic and dental implants, implant material, 145 145-146 see also Silver on alumina see also Nanophase ceramics

PS068-Ind.xml

206

### **INDEX**

Bioglasses structural organization of implant material, 145 microarchitecture, 131 surface modification, 147-148 time course of osteoblast function, 137 Biomaterials, see Orthopedic and dental vitronectin, 135-136 implant materials wound-healing response, 141 β-Bismuth molybdate, hydrodynamic see also Orthopedic and dental implant cavitation, 33-34 materials Bismuth nanowires calculated effective density of states, 189 C carrier density, 190-191 density of states of electrons, 188 parameters determining electronic Cabot flame process, high-surface-area properties, 186-187 nanostructured materials, 11 pressure injection method, 173-177 Calcium fluoride scanning electron microscopy (SEM) evidence for shock wave heating, 31-32 image of, on anodic alumina template, Tamman temperature, 32 Carbon, see Activated carbon smallest diameter, 177 Carbon nanotubes temperature-dependent resistivity, derivatives of C<sub>60</sub> buckyballs, 118-119 194-196 vapor deposition, 180–181 temperature-dependent resistivity of Carrier density, bismuth nanowires, 190-191 Bi-Te alloys, 196-197 Catalysis, supported metal complexes, 62-63 transmission electron microscopy (TEM) Catalysts image of cross section, 175, 176 connections of supported nanoclusters to X-ray diffraction (XRD) patterns, 176, 177 industrial, 72 see also Nanowires single-site, 51 Bonding supported metal nanoclusters, 73  $\pi$ -complexation sorbents, 114–117 supported nanostructures, 50-51 supported metal complexes, 62 see also Nanostructured catalysts supported metal nanoclusters, 73 Catalytic properties nanostructured materials, 6-8 Bone bone-modeling unit (BMU), 139 supported metal nanoclusters, 70-72 cells of bone tissue, 136-139 supported nanoparticles, 73 chemical composition of matrix, 131-136 Cations collagen, 132-133 effects of, charge and ionic radius, cutter-cone, 139 105 - 108fibroblasts, 138-139 effects of, sites on zeolites, 102-105 fibronectin, 134-135 interactions of zeolites with, 100-108 inorganic phase, 132 CaviMax processor laminin, 133-134 description, 26 mechanical properties, 128, 129 experimental, 23-25 microarchitecture, 128, 130-131 experiments, 26 microarchitecture and structural see also Hydrodynamic cavitation classification, 130 CaviPro processor characterizing fluid flow, 26 noncollagenous proteins, 133-136 organic phase, 132-136 description, 25 osteoblasts, 136-138 experimental, 23-25 osteoclasts, 138 flow configuration, 24 physiology, 128-140 see also Hydrodynamic cavitation remodeling, 139-140 Cavitation, see Hydrodynamic cavitation

### INDEX

Cell adhesion, protein-mediated, on biomaterials, 143-145

Ceramics

hydrodynamic cavitation, 3 orthopedic and dental implants, 145 surface modification, 147-148 see also Nanophase ceramics

Chemical Engineering-v27

Chemical composition of bone

bone matrix, 131-136 collagen in human body, 132-133 fibronectin in bone matrix, 134-135

inorganic phase, 132 laminin in basement membrane of tissues, 133-134

noncollagenous proteins in bone matrix, 133-136

organic phase, 132-136

vitronectin, 135-136

Chemical etching, porous templates, 171-172

Chemical modifications, implant materials, 147-148

Chemical vapor deposition, nanowires, 179

Cluster structures

change in grain size, 5

ion-bombardment technique, 7-8

Cobalt molybdates, hydrodesulfurization catalysts, 2-3

Collagen, human body, 132-133

Combustion flame-chemical vapor

condensation (CF-CVC) nanostructured materials, 10-11

schematic, 10

 $\pi$ -Complexation sorbents

description, 108-109

effects of cation, anion, and substrate, 112-113

electron population changes on d orbitals, 116

electron redistribution, 116-117

energy of adsorption for MCl-C<sub>2</sub>H<sub>4</sub> and MCl-CO systems, 112

equilibrium isotherms of C<sub>2</sub>H<sub>4</sub> over C<sub>2</sub>H<sub>6</sub> on AgNO<sub>3</sub>/SiO<sub>2</sub>, 111

equilibrium isotherms of C<sub>3</sub>H<sub>6</sub> over C<sub>3</sub>H<sub>8</sub> on AgNO<sub>3</sub>/SiO<sub>2</sub>, 111

nature of  $\pi$ -complexation bond, 114–117 normalized C<sub>3</sub>H<sub>6</sub> adsorption isotherm on

AgX salts, 113 olefin-diene separation and purification, 117

207

olefin-paraffin separations, 109-111 schematic of metal-olefin complex, 115

selective acetylene adsorption, 117

separating aromatics from aliphatics, 117 spontaneous monolayer dispersion, 110

summary of natural bond orbital (NBO)

analysis between MX and C<sub>2</sub>H<sub>4</sub>, 114

summary of NBO analysis between MX and C<sub>3</sub>H<sub>6</sub>, 115

Composition, supported metal complexes, 53

Coordination chemistry, supported metal complexes, 52-53

Copper-modified zinc oxide

grain sizes and crystallographic strain, 39 hydrodynamic cavitation, 38-39

Crystallographic strain

copper-modified zinc oxide, 38-39

hydrodynamic cavitation, 34-39

piezoelectrics, 37-38

titania, 35-37

Cutter-cone, bone remodeling, 139

### D

Decarbonylation, supported metal nanoclusters, 67

Dendrimers, polymer-mediated synthesis, 14 - 15

Density of states, bismuth nanowires, 188, 189

Dental implants, see Orthopedic and dental implant materials

Deprotonation of hydrido metal, supported metal nanoclusters, 66

Diffusive transport, 191

Dipole moment, effect on adsorption, 84-85 Dispersion

contribution to potential energy for

adsorption, 81-82 Lennard-Jones potential, 83

# $\mathbf{E}$

Electrochemical deposition advantage, 179

choosing template, 178

contrast to pressure injection, 178-179

nanowire fabrication, 177-179

### **INDEX**

Electronic charge, sorbent design, 85-86 Electronic materials, hydrodynamic cavitation, 3 Electronic properties, nanostructured materials, 4-5 Electron redistribution phenomenon of d orbitals, 116-117 schematic, 117 Endothelial cells, protein-mediated cell adhesion on biomaterials, 143

Chemical Engineering-v27

### F

Fibroblasts formation of fibrous, connective tissue, 138 - 139protein-mediated cell adhesion on biomaterials, 143 Fibronectin glycoprotein, 134-135 schematic of structure, 135 Fluid-flow conditions Ag on alumina, 41-42 high-temperature stable oxidation catalysts, 40-41 Pd on zirconia-alumina, 40-41 synthesis under variable, 39-42 variable phases under different bubble dynamics, 41-42

## G

Gas phase condensation dc- and rf-magnetron sputtering, 11 deposition of palladium on silicon carbide support, 12 nanostructured materials, 11-12 Geometry, sorbent design, 87-88 Glycoproteins fibronectin, 134-135 integrins, 143-144 laminin, 133-134 vitronectin, 135-136 Gold particles preparation on titania and iron oxide supports, 6-7 protein microtube-mediated synthesis, 16

Grain size change resulting in cluster formation, 5 nanostructured metals and alloys in varying, 12 varying size of crystallites, 4

PS068-Ind.xml

### H

Heteropoly compounds, nanostructured

adsorbents, 119 High-powered ultrasound

metal oxides and supported metal catalysts, 3 metal oxides and supported metal oxides, 17 - 18High temperature aerosol decomposition, catalyst synthesis, 3 Hydrodynamic cavitation advanced catalysts, ceramics, and electronic materials, 3  $\beta$ -bismuth molybdate, 33–34 Bernoulli effect, 22 bubble formation-collapse-reformation dynamics, 22 calcium fluoride, 31-32 CaviMax and CaviPro processors, 23-24 copper-modified zinc oxide with crystallographic strain, 38-39 equipment, 21-22 experimental, 23-25 flow configuration in CaviPro, 24 high-temperature stable oxidation catalysts, 40-41 introduction of crystallographic strain, 34 - 39La<sub>0.6</sub>Sr<sub>0.4</sub>FeO<sub>3</sub> perovskites, 25 MoO<sub>3</sub> synthesis, 28–32 nanostructured catalyst in high-phase purity and varying grain sizes, 32 - 34piezoelectrics with crystallographic strain, 37-38 relationship of double-orifice cavitation generator to model, 23 Reynolds and throat cavitation numbers, 25-27 schematic, 21 schematic of cavitation bubbles interacting

with slurry, 22

INDEX

209

synthesis of metal oxide catalysts and supported metals, 27 technique, 20 titania synthesis, 25 titania with crystallographic strain, 35-37 typical experiment, 24-25 variable fluid-flow conditions, 39-42 variable phases under different bubble dynamics, 41-42 X-ray diffraction (XRD) experiments, 25 XRD of La<sub>0.6</sub>Sr<sub>0.4</sub>FeO<sub>3</sub>, 33 Hydroxyapatite, implant material, 145

Industrial catalysts, connections of supported nanoclusters to, 72 Inorganic phase, bone, 132 Integrins expression by osteoblasts, 144 function, 144 glycoproteins, 143-144 Ion-bombardment technique, metal cluster formation, 7-8 Ionic radii, alkali and alkaline earth metal ions, 87  $Ir_4(CO)_{12}$  and  $Ir_6(CO)_{16}$ , supported metal nanoclusters, 68-69 Ir4 in zeolite NaX supported metal nanoclusters, 69 theoretical investigation, 70 Iron oxide support, preparation of gold particles on, 6-7

### K

Kirkwood-Muller formula, potential energies for adsorption, 83

### L

Laminin glycoproteins, 133-134 schematic of structure, 134 Laser-assisted synthesis future research in laser ablation, 183-184

laser ablation-condensation, 181-182 nanowires, 181-184 schematic of silicon nanowires, 181 Lyotropic liquid-crystal template, polymer-mediated synthesis, 15

#### M

MCM-41 development by sol-gel route, 94 host matrices for nanowire fabrication, 172-173 mesoporous silicate/aluminosilicate, 94 modifications to be useful, 96 pore structure and volume, 95 promising applications, 96 schematic of formation, 95 synthesis and tailoring structure and properties, 95 Mechanical properties bone, 128, 129 nanophase ceramics, 156-159 Metal alloys implant material, 145 surface modification, 147-148 Metal clusters, ion-bombardment technique, 7-8 Metal complexes, see Supported metal complexes Metal nanoclusters, see Supported metal nanoclusters Metal-olefin complex, schematic, 115 Metal oxidation state, supported metal complexes, 53-54 Metal oxides catalysts by hydrodynamic cavitation, 27 high-powered ultrasound, 3, 17-18 schematic of hydrodynamic cavitation synthesis, 21 Metal pair sites on supports, 63-64 Metalloorganic chemical vapor deposition, nanowires, 179 Metals orthopedic and dental implants, 145 surface modification, 147-148 MgO, Os<sub>5</sub>C on, 69 MgO supports, rhenium carbonyl precursors,

**INDEX** 

Mica film fabrication, 172 scanning electron microscopy (SEM) image, 172 Microarchitecture bone, 128, 130-131 structural organization of bone, 131 Microwave reactor, examining nanostructured catalyst synthesis, 19 - 20Molecular-sieve carbon, pore size distribution, 89 Molecular-sieve zeolites, commercial use, 80 Molybdenum carbide, Mo<sub>2</sub>C, sonochemical synthesis, 16-17 Molybdenum species, SiO<sub>2</sub>-supported, 63 MoO<sub>3</sub> synthesis calcium fluoride for evidence of shock wave heating, 31-32 CaviPro and CaviMax processors, 28-29 cavitational heating, 31 computed activation energy, 30 degree of in situ calcination, 28 reaction rate calculation, 30 sample from lowest temperature oven calcination, 29-30

shock wave, 30
XRD analysis of oven-calcined ammonium molybdate, 29

high edge-to-basal plane ratio, 6 sonochemical synthesis, 16

# N

Nanochannel glass (NCG)
scanning electron microscopy (SEM), 173
schematic of fabrication, 173
template-assisted synthesis of nanowires,
172
Nanoparticles, see Supported nanoparticles
Nanophase ceramics
adhesion of osteoblasts to ceramic
surfaces, 152–153
bending properties, 158
enhancing osteoblast and osteoclast
functions, 153–155
experimental evidence on mechanical
properties, 157–159

experimental evidence on surface properties, 150-156 extent of osteointegration of calcium phosphate with juxtaposed bone, 151 mechanical properties enhancing implant efficacy, 156-159 mechanism of osteoblast adhesion, 151-152 porosity changes, 158–159 rationale for mechanical properties, 156-157 rationale for surface properties, 149-150 representative topography of nanophase and conventional titania, 154 schematic deformation properties of, 157 studies on ectopic bone formation, 150 surface properties for enhanced implant efficacy, 149-156 theoretical predictions of changes in surface properties, 149 topography, 152 unfolding of vitronectin for osteoblast adhesion on, 155 see also Orthopedic and dental implant materials Nanostructured adsorbents activated alumina and silica gel, 93-94 activated carbon, 88-91 basic considerations for sorbent design, carbon nanotubes, 118-119 commercial use of adsorption, 80  $\pi$ -complexation sorbents, 108–117 contributions to initial heat of adsorption, 85 dipole moment, 84-85 dispersion, 82 dispersion, electrostatic, and chemical bond contributions, 81-82 effects of adsorbate properties on adsorption, 84-85 factors for designing adsorbents, 81-88 field and induced-point dipole, 82 field and point dipole, 83 field gradient and linear point quadrupole, 83 heat of adsorption, 83-84

heteropoly compounds, 119 individual contributions, 82

ionic radii, 87

### **INDEX**

Kirkwood-Muller formula, 83 metal oxide catalysts and supported metals Lennard-Jones potential, 83 by hydrodynamic cavitation, 27 nonspecific contributions, 82 microwave reactor examining synthesis, pillared clays, 120 19 - 20piezoelectrics with crystallographic strain, polarizabilities of ground-state atoms and ions, 86 37 - 38polarizability, 84-85 schematic of hydrodynamic cavitation, 21 polarizability, electronic charge, and van throat cavitation number, 26 der Waals radius, 85-86 titania with crystallographic strain, 35-37 pore size and geometry, 87-88 typical experiment, 24-25 potential energies for adsorption, 81-83 variable fluid-flow conditions, 39-42 quadrupole moment, 84-85 variable phases under different bubble recent developments on activated carbon, dynamics, 41-42 91 - 92X-ray diffraction (XRD) experiments, 25 repulsion, 82 see also MoO3 synthesis threshold pressure for adsorption in Nanostructured materials different pore sizes and shapes, 87 barium hexaaluminate by reverse zeolites, 96-108 microemulsion, 13-14 see also Activated carbon; Cabot flame process, 11  $\pi$ -Complexation sorbents; Zeolites catalytic properties, 6-8 Nanostructured catalysts combustion flame-chemical vapor acoustic cavitation, 19 condensation process (CF-CVC), aerosol catalyst studies, 19 10 - 11 $\beta$ -bismuth molybdate and perovskite factors responsible for rate acceleration, 6 La<sub>0.6</sub>Sr<sub>0.4</sub>FeO<sub>3</sub>, 33-34 formation of cluster structures, 5  $\beta$ -bismuth molybdate using both CaviMax gas phase condensation synthesis, 11–12 processors, 34 high metal atom surface-to-volume ratio, CaviMax and CaviPro processors, 23-26 cavitational devices, 23-24 high-powered ultrasound, 3, 17-18 characterization of Reynolds and throat high-temperature aerosol decomposition (HTAD) process, 3 cavitation numbers, 25–27 classical approach, 18 hydrodesulfurization catalysts, 2-3 copper-modified zinc oxide with hydrodynamic cavitation, 3 crystallographic strain, 38-39 ion-bombardment technique, 7 crystallographic strain by hydrodynamic ionization potential, 4 cavitation, 34-39 MoS<sub>2</sub> with high edge-to-basal plane ratio, 6 engineered synthesis, 18-19 new synthesis processes, 2 equipment for hydrodynamic cavitation, palladium on silicon carbide support, 12 21 - 22polymer-mediated synthesis, 14-15 estimating in situ calcination temperature preparation of gold particles on titania and in MoO<sub>3</sub> synthesis, 28-32 iron oxide, 6-7 experimental procedures, 23-25 progress in synthesis processes, 8-9 high-temperature stable oxidation properties and reactivities, 3-8 catalysts, 40-41 protein microtubule-mediated synthesis, hydrodynamic cavitation, 20-23 15 - 16hydrodynamic cavitation with high-phase reverse micelle synthesis, 12-14 purities and varying grain sizes, sol-gel and precipitation technologies, 9-10 mechanical techniques affording changes, sonochemical synthesis, 16-18 18-19 structure and electronic properties, 4-5

### **INDEX**

PS068-Ind.tex

Nanostructured materials (continued) synthesis for advanced catalysts, 2-3 synthesis of TiO<sub>2</sub> by aerosol process, 6 varying grain size of crystallites, 4 Nanowires advances in low-dimensional systems, 198 anodic alumina templates, 169-170 antimony nanowires, 197-198 ballistic transport, 191 band structures of one-dimensional systems, 185-188 bismuth, 175-177 calculated effective densities of states for bismuth nanowires 189 calculated subband energies as function of in-plane mass anisotropy, 188 carbon nanotubes, 180-181 carrier densities, 190-191 diffusive transport, 191 dispersion relation of electrons, 185 electrochemical deposition, 177-179 extension beyond gas-phase reaction for Si nanowires, 184 further research in laser ablation, 183-184 grid points transforming differential equation into difference equation, 187 laser ablation-condensation, 181-182 laser-assisted synthesis, 181-184 mica films, 172 molecular sieve MCM-41, 172-173 nanochannel glass (NCG), 172 parameters determining electronic properties, 186-187 physical vapor deposition, 179-180 pressure injection method, 173-177 processing of anodic alumina films, 170 progress in deriving, 168-169 resistance R(T)/R(270 K) for Bi-Te nanowire alloys, 196-197 schematic of pressure injection setup, 174 schematic of semimetal-semiconductor transition, 189 self-organized pore structure of anodic alumina, 171 semiclassical model of transport, semimetal-semiconductor transition in semimetallic, 188-191

silicon nanowires, 181-183

techniques to prepare one-dimensional systems, 184-185 temperature dependence of resistance for bismuth nanowire arrays, 194-196 temperature-dependent resistivity, 193-198 template-assisted synthesis, 169-181 template fabrication by chemical etching, 171 - 172theoretical modeling of band structures, 185-191 transport properties, 191-198 vapor deposition, 179-181 vapor-liquid-solid (VLS) growth, 181 Natural bond orbital (NBO),  $\pi$ -complexation sorbents, 114–115 Noncollagenous proteins bone matrix, 133-136 fibronectin, 134-135 laminin, 133-134 vitronectin, 135-136

### o

Olefin–paraffin separation,  $\pi$ -complexation sorbents, 109-111 Organic phase bone, 132-136 collagen, 132-133 fibronectin, 134-135 laminin, 133-134 noncollagenous materials, 133-136 vitronectin, 135-136 Organometallic chemistry, supported metal complexes, 52 Orthopedic and dental implant materials bioceramics, 145-146 chemical modifications, 147-148 comparing mechanical properties of, and bone, 146 conventional, 127 costs, 126-127 current materials, 145-148 fate of implanted device, 140-141 integration into surrounding tissue, 127 integrin expression on osteoblasts, 144 integrins, 143-144 metals, ceramics, and polymers, 145 next generation, 127, 148-159

Chemical Engineering-v27

novel surface modifications of conventional, 147-148

peptide sequence

tyrosine-arginine-serine-arginine (KRSR), 144-145

protein interactions with biomaterial surfaces, 141-143

protein-mediated cell adhesion on biomaterials, 143-145

schematic of protein-mediated cell

adhesion on biomaterials, 142 surface roughness, 147

tissue-implant interface, 140-145 use, 126-127

wound-healing response of bone, 141 see also Nanophase ceramics

Os<sub>5</sub>C on MgO, supported metal nanoclusters, 69

Osmium di- and tricarbonyls on γ-Al<sub>2</sub>O<sub>3</sub>,

supported metal complexes, 61

Osteoblasts

adhesion to ceramic surfaces,

152-153

bone-forming cells, 136-138

bone remodeling, 139-140

integrin expression by, 144

mechanism of vitronectin mediating, adhesion, 151-152

nanoceramics enhancing, 153-155

periods of differentiation, 136, 137

protein-mediated cell adhesion on

biomaterials, 143 surface modifications of implant materials, 147-148

unfolding of vitronectin for, adhesion, 155

Osteoclasts

bone remodeling, 139-140

bone-resorbing cells, 138

nanoceramics enhancing, 153-155

Palladium

dendrimers, 14-15

protein microtube-mediated synthesis,

15 - 16

silicon carbide support by

plasma-sputtering, 12

synthesis on zirconia-alumina,

40-41

X-ray diffraction for 2% Pd on

zirconia-alumina, 40

Perovskite La<sub>0.6</sub>Sr<sub>0.4</sub>FeO<sub>3</sub>

hydrodynamic cavitation, 33-34

synthesis of family, 25

Physical vapor deposition, nanowires, 179 - 180

Physiology, see Bone

Piezoelectrics, hydrodynamic cavitation,

Pillared interlayered clays (PILCs), nanostructured adsorbents, 120

Platinum, dendrimers, 14-15

Polarizability

effect on adsorption, 84-85

ground-state atoms and ions, 86

sorbent design, 85-86

Polycarbonate membrane

chemical etching, 171-172

scanning electron microscopy of particle

track-etched, 172

Polyethylene, implant material, 145

Polymer-mediated synthesis, dendrimers,

Polymers, orthopedic and dental implants,

145 Poly(methyl methacrylate), implant material,

Pore size, sorbent design, 87-88

Potential energy, adsorption, 81-83

Precipitation, nanostructured materials, 9-10

Pressure injection

bismuth nanowires, 175-177

experimental setup, 174

nanowire fabrication, 173-177

template requirements, 175

Washburn equation, 174-175

Pressure swing adsorption, adsorption, 80

Protein microtube-mediated synthesis,

nanostructured materials, 15-16

Purification, olefin-diene, 117

Q

Quadrupole moment, effect on adsorption, 84-85

### **INDEX**

R Reactivity supported metal complexes, 62-63 supported metal nanoclusters, 73 Repulsion contribution to potential energies for adsorption, 82 Lennard-Jones potential, 83 Reverse micelle process combining with standard sol-gel, 13 inverse micelle synthesis of nanostructured reduced metals, 13 nanostructured materials, 12-14 silver on fine-grain silica, 13 Reynolds number, characterization, 25-27 Rh<sub>6</sub>(CO)<sub>16</sub>, supported metal nanoclusters, 68 Rhenium carbonyl precursors, MgO supports, 64 Rhenium tricarbonyl on MgO preparation, 58 structural assignments and infrared spectra, 59 supported metal complexes, 58-61 theoretical and experimental agreement, 60 - 61Rhodium dicarbonyls on dealuminated Y zeolite EXAFS spectra and predictions of density functional theory, 57 infrared spectra in carbonyl stretching region, 56 model, 55 supported metal complexes, 54-56 Rhodium dicarbonyls on γ-Al<sub>2</sub>O<sub>3</sub>, supported

## S

Semimetallic nanowires carrier density, 190-191 schematic of transition, 189 semimetal-semiconductor transition, 188-191 Separations aromatic from aliphatic, 117 olefin-diene, 117 Silica gel amorphous, 93

metal complexes, 58

commercial, 93 commercial use, 80 pore size distribution, 89 sol-gel processing, 93-94 Silicon carbide support, palladium deposition by plasma-sputtering, 12 Silicon nanowires schematic, 181 transmission electron microscopy (TEM) images, 182-183 vapor-liquid-solid (VLS) growth, 181, 184 Silver on alumina variable phases under different bubble dynamics, 41-42 X-ray diffraction patterns, 41 SiO<sub>2</sub> supports molybdenum species, 63 tungsten species, 63 Sol-gel advantages, 9 combining with inverse micelle technique, 13 development of MCM-41, 94 nanostructured materials, 9-10 silica gel, 93-94 Sonochemical synthesis metallic and bimetallic catalysts, 16 molybdenum carbide (Mo<sub>2</sub>C), 16-17 MoS<sub>2</sub>, 16 nanostructured materials, 16-18 Sorbent design polarizability, electronic charge, and van der Waals radius, 85-86 pore size and geometry, 87-88 Spontaneous monolayer dispersion,  $\pi$ -complexation sorbents, 110 Structure characterization for supported metal complexes, 54 characterization for supported metal

PS068-Ind.xml

nanoclusters, 67 nanostructured materials, 4-5 supported metal complexes, 62 supported metal nanoclusters, 73 zeolites, 97, 98-99 Subband energies bismuth nanowires, 186-187 calculated, as function of in-plane mass

anisotropy, 188 Supported metal complexes Chemical Engineering-v27

215

composition determination, 53 coordination chemistry, 52-53 examples, 54-62 metal oxidation state determination, 53-54 organometallic chemistry, 52 osmium di- and tricarbonyls on  $\gamma$ -Al<sub>2</sub>O<sub>3</sub>, preparation, 52-53 reactivity and catalysis, 62-63 rhenium tricarbonyls on MgO, 58-61 rhodium dicarbonyls on dealuminated Y zeolite, 54-56 rhodium dicarbonyls on γ-Al<sub>2</sub>O<sub>3</sub>, 58 single-site catalysts, 51 spectroscopic and theoretical characterization of structure, 54 structure and bonding, 62 tantalum hydride complexes on SiO2, 62 Supported metal nanoclusters catalytic activities of extremely small clusters, 72 catalytic properties, 70-72 cluster-size dependence, 72 connections to industrial catalysts, 72 decarbonylation of neutral or anionic metal carbonyl clusters, 67 deprotonation of hydrido metal carbonyl cluster, 66 EXAFS results characterizing, 71 examples, 68-70 Ir<sub>4</sub> in zeolite NaX, 69, 70  $[Ir_4(CO)_{12}]$  and  $[Ir_6(CO)_{16}]$ , 68–69 metal carbonyl clusters, 66 Os<sub>5</sub>C on MgO, 69 preparation, 65-67 [Rh<sub>6</sub>(CO)<sub>16</sub>], 68 solution reactions in presence of reducing agents, 66-67 structural characterization, 67 structure, bonding, reactivity, and catalysis, 73 surface chemistry, 66 syntheses in zeolite cages, 67 theoretical metal-metal distances, 70 Supported metals, hydrodynamic cavitation, Supported nanoparticles, properties, 73 Surface chemistry, supported metal

nanoclusters, 66

Surface properties, nanophase ceramics, 149-156 Surface roughness, modifications of implant materials, 147 Surface-to-volume ratio, metal atom, 4-5

PS068-Ind.xml

T Tantalum hydride on SiO2, supported metal complexes, 62 Template-assisted synthesis anodic alumina templates, 169-170 description, 169 electrochemical deposition, 177-179 nanowires, 169-181 pressure injection, 173-177 vapor deposition, 179-181 Throat cavitation number characterization, 25-27 definition, 26 TiO<sub>2</sub>, aerosol process, 6 Tissue-implant interface fate of implanted device, 140-141 protein interactions with biomaterial surfaces, 141-143 protein-mediated cell adhesion on biomaterials, 143-145 wound-healing response of bone, 141 see also Orthopedic and dental implant materials Titania correlation of applied pressure, crystallographic strain, and Reynolds number-throat cavitation number, 36 grain size and crystallographic strain data, hydrodynamic cavitation, 35-37 preparation of gold particles on, 6-7 synthesis of nanostructured, 9-10 topography of nanophase and conventional, 154 Topography nanophase and conventional titania, 154 nanophase ceramics, 152 Transport properties antimony nanowires, 197-198 bismuth nanowires, 194-196 Bi-Te alloys, 196-197

reduced chemical potential, 193

09:29 AM

**INDEX** 

Transport properties (continued)
semiclassical model, 192–193
temperature-dependent resistivity of
nanowires, 193–198
Triplet sites on supports, 63–64
Tungsten species, SiO<sub>2</sub>-supported, 63
Turnover numbers (TON), nanostructured
materials, 6
Tyrosine-arginine-serine-arginine (KRSR),

#### v

enhancing osteoblast adhesion, 144-145

van der Waals radius, sorbent design, 85–86
Vapor deposition
carbon nanotubes, 180–181
nanowire preparation, 179–181
Vapor-liquid-solid (VLS) growth, silicon
nanowires, 181, 184
Vapor-phase synthesis, oxygen
nonstoichiometry, 11
Vitronectin
bone matrix, 135–136
mechanism mediating osteoblast adhesion,
151–152
schematic of structure, 135
unfolding for osteoblast adhesion, 155

# w

Washburn equation, pressure injection process, 174–175 Wound healing, response of bone, 141

### $\mathbf{Z}$

Zeolite cages, supported metal nanoclusters, 67

Zeolites adsorption, 80 adsorption properties, 99-100 anionic oxygens and isolated cations, 99-100 components of interaction energies for CO<sub>2</sub> adsorbed on X zeolite, 107 description, 96-97 effects of cation charge and ionic radius, 105-108 effects of cation sites, 102-105 electrostatic interactions, 105-106 energy terms for NH3 on X zeolite, 107 geometry-optimized cluster model, 101 heat of adsorption versus surface coverage, 105 interaction energies between molecules and isolated cations, 106 interaction potentials for CO<sub>2</sub> and NH<sub>3</sub>, 107-108 interactions with cations, 100-108 Ir<sub>4</sub> in zeolite NaX, 69, 70 line representation of structure, 97 N<sub>2</sub> adsorption isotherms for Ag/LSX (low silica X), 103 N<sub>2</sub> and O<sub>2</sub> adsorption capacities for Li faujasite, 103 naturally occurring, 97–98 pore size distribution, 89 relative electronegativities of zeolite anion and halides, 101 site II cation on six-membered oxygen sodalite and hexagonal prism site I and II

sodalite and hexagonal prism site I and II cation locations in Ag/faujasites, 104 structures and cation sites, 98–99 type A, 98–99 types X and Y, 99
Zinc oxide, copper modified, 38–39