

Index

a

acetaminophen 183
 actinomycin D (AMD) 169
 acyclic L-threonol nucleic acid (L-aTNA) 17, 18
 adenosine triphosphate (ATP) 70, 110, 116
 adipo-8 148
 adipose tissue 147, 148
 allele mutation detection method 107
 allicin 148
 ampicillin-loaded tFNAs 44
 angiogenic peptide loaded tFNAs 15
 antibiotic resistance 45, 51, 161, 162, 168
 antibodies vs. aptamers 5
 antibody-based HCR system 107, 108
 antimicrobial peptides (AMPs) 161, 162, 166, 169–171
 antisense oligonucleotides (ASOs) 64–65, 70, 116, 129, 141, 149, 162, 163, 168, 169, 184, 187
 antisense peptide nucleic acids (asPNAs) 168, 169
 apolipoprotein B (ApoB) 142, 149
 aptamers 5, 129, 142, 150, 184, 187
 antibodies vs. 5
 AS1411-modified tFNAs 41
 based HCR system 108–109
 functionalized DNA origami delivery
 nanostructures 51
 modified DNA origami 45
 modified tetrahedral framework DNA 172
 targeted drug delivery 49
 tFNAs 126

arm-acceptor hairpins 107
 arm-donating hairpins 107
 artificial DNA nanostructures 141
 artificial nucleic acids (XNAs) 4, 17–18
 ATP-responsive HCR-based logic gate 110
 autocatalytic HCR biocircuit 103–105

b

bacterial magnetosomes 86, 87
 β-lactamases 170
 bioimaging of bone tissue regeneration 93–94
 biological polymer DNA 37
 bionanomaterials 7, 86
 bioscaffold materials 81
 biosensing 2, 3, 7, 37, 82, 84–86, 139, 141, 184
 bone defect 15, 81, 90, 92–94
 bone-related diseases 81–94
 bone tissue engineering 81, 93, 94
 “bottom-up” approach 1
 BSA-coated DNA origami 21

c

carbazole derivative BMEPC 44
 carbon-based nanomaterials 84, 85, 87
 caveolin-mediated endocytosis 41, 150
 cDNA 106, 188, 192
 cell targeting 47, 49, 53, 65, 66, 68, 184
 chemical antibodies 49
 chemotherapy 46, 51, 68, 115, 116, 123, 124, 127, 129, 130

- chitosan-based injectable thermosensitive hydrogel scaffold structure 93
- chondrocyte affinity peptide (CAP) exosomes 188
- circular RNA (CircRNA) 192, 194
- clearing mutant mtDNA 62–64
- clindamycin-tFNAs complex 15
- composite nanomaterials 7, 84, 87
- curcumin-loaded tFNAs 15
- cytosine-phosphate-guanine oligodeoxy nucleotides (CpG ODNs) 127
- d**
- dendritic oligonucleotide-coated DNA brick nanostructures 21
- deoxyribonucleic acid (DNA) 3
- based nanocomposite hydrogels 146
 - DNA-based nanomaterials 2
 - history of 3–9
 - hydrogel nanostructures, in antibacterial field 170
 - hydrogels 162
 - logic gate-based HCR 112
 - nanomesh 26
 - nanoribbons 170
 - nanostructures 16, 162
 - advantages in antibacterial field compatibility 163
 - compatibility 163
 - challenges and perspectives 172
 - drug-loading performance 164
 - editability 163
 - ϵ -poly-L-lysine-DNA nanocomplex 166
 - five “holes” origami framework 164
 - melamine-DNA-AgNC complex 165–166
 - NET-like nanogel based on 2D DNA networks 166
 - stability 163
 - super silver nanoclusters based 164, 165
 - 3D application 166, 170
 - nanotechnology 161
 - origami 6, 7, 22, 127–129, 161
 - origami techniques 38, 144
 - origami technology 124
 - six-helix bundle (6HB) 169
 - tetrahedron 39, 144
 - tiles 6
 - diabetes mellitus (DM) 144–146
 - diacylglycerol acyltransferase-2 (DGAT2) 142, 146, 149
 - disulfide crosslinking 23
 - DNA Pom-Pom nanostructure (DNA PP-N) 170
 - DNA scaffold strand 38
 - DNAzymes 4, 5, 103
 - double-crossed (DX) molecules 6
 - DOX-loaded DNA origami nanosystem 52
 - doxorubicin (DOX) origami delivery system 128
 - dual miRNA detection system 111
 - dynamic DNA nanostructures 123, 124, 130–133
- e**
- Emapticap pegol (NOX-E36) 145
- enhanced permeability and retention (EPR) effects 128
- enzymatic ligation 22–23
- ϵ -poly-L-lysine-DNA nanocomplex 166
- erythromycin-loaded tFNA 44
- exosomes 86, 188
- f**
- FD-RNA 68
- fluorescence-based detection 101
- 2'-fluoroarabinonucleic acid (FANA) 18
- FNA-MSN nanomaterial 85
- folate 46, 47
- framework nucleic acids (FNAs) 37, 124
- advantages 37, 38
 - biological properties 40–41
 - classification and construction 38–40
 - delivery systems in biomedical application
 - controlled drug release 49–51
 - efficient drug delivery 46
 - overcoming drug resistance 49–51
 - targeted drug delivery 46–49
- DNA tetrahedron 39

- fabrication and properties 39
 physical and chemical properties 40
 phytochemicals 45
 small-molecule drugs 41
 antibiotic agents 44–45
 anticancer agents 42–45
 phytochemicals 45
 functional nucleic acids (FNAs) 4
 aptamers 5
 DNA microchips 84
 DNA nanobots 84
 DNA origami 6, 83
 DNA tile 83
 DNA tiles 6
 DNAzymes 4
 three-dimensional DNA self-assembly 83–84
 triplex DNA 5–6
- g**
 G4 17, 18
 gamma-modified PNA(γ PNA) 17
 glioma-specific peptide-modified tFNAs 49
 glucagon 145, 146
 glutaraldehyde-mediated chemical crosslinking, of oligolysine-PEG5K 21
 coated DNA nanostructures 21
 graphene-encapsulated DNA nanostructures 22
- h**
 HApt-tFNA 126
 hybridization chain reaction (HCR) 101
 based assembly nanoplates 113, 114
 based *in situ* fluorescence imaging and biotherapy 102
 based oligonucleotide drug delivery system 116
 based tumor biotherapy 115
 chemotherapy 115
 photodynamic therapy 115–116
 RNA interfering therapy 116
 components 102
 hairpin design principles 102
 miRNA detection 103
 autocatalytic HCR biocircuit 103–104
 nonlinear HCR system 104–105
 multiple target detection 109
 combined HCR-based probe 109–110
 HCR-based logic gate 110–113
 vs. polymerase chain reaction 102
 protein detection
 antibody-based HCR system 107, 108
 aptamer-based HCR system 108–109
 single-nucleotide variants detection 105–107
 hybrid protein-DNA hydrogel 93
- i**
 immunotherapy 2, 53, 123, 126, 127
- l**
 label-free HCR-based PTD method 115
 L-DNA 17
 ligand-modified FNAs 46
 L12-loaded DNA hydrogel 171
 LncRNAs 65
 locked nucleic acid (LNA) 20, 88, 187
- m**
 magnetic bead nanoparticles 86
 magnetic nanomaterials 86–87
 magnetotaxis 87
 melamine-DNA-AgNC complex 165–166
 melittin-loaded DNA nanostructure 124
 mesoporous silica nanoparticles (MSN) 85
 messenger RNA (mRNA) 64, 65, 91, 92, 102, 103, 113, 126, 142, 146, 147, 149, 184, 187, 188, 192
 metabolic diseases 61, 139–150
 metal-based nanomaterials 7, 84–85, 87
 metallo- β -lactamases (M β Ls) 170
 metal nanoclusters 85
 methionine adenosyltransferase (MAT) 147
 8-methoxysoralen (8-MOP) 23
 microfluidic technology 110, 117
 micropinocytosis-related proteins 41
 microRNA-155 loaded tFNAs 15

- microRNAs (miRNAs) 126
 detection
 autocatalytic HCR biocircuit 103–104
 nonlinear HCR system 104–105
 mimics 188
- mitochondrial DNA (mtDNA) 61
 clearing mutant 62–64
 inhibiting replication 64
- mitochondria targeting 66–68
- mitochondria treatment, nucleic acid-based
 delivery system in 68–71
- molecular data storage 8
- molecular nanotechnology 1
- mtRNA
 increase normal RNA 64
 non-coding RNA treating 65
 silencing abnormal RNA 64–65
- multifunctional DNA origami nanostructure 129
- multiple target detection
 combined HCR-based probe 109–110
 HCR-based logic gate 110–113
- n**
- naked plasmids 194
- nanotechnology 1, 3, 4, 6, 37, 52, 81–83, 88, 103, 124, 139, 161, 164, 172
- natural nucleic acids 3
- NET-like DNA-HCl-ZnO nanogel 166
- NET-like nanogel based on 2D DNA networks 166
- nonalcoholic fatty liver disease (NAFLD) 140, 148, 149
- nongenetic nucleic acids 4, 141
- nonlinear HCR system 104–105, 116
- nonsteroidal anti-inflammatory drugs (NSAIDs) 183
- Notch receptors 147
- NOX-G15 145
- nuclease degradation 16, 20, 21, 26
- nucleic acid-based amplification reaction 101
- nucleic acid-based antitumor treatment 101
- nucleic acid-based functional nanomaterials 82
- bionanomaterials 86
- in bone tissue repair and regeneration 89
 bioimaging 93
 bone targeting 91–92
 scaffold material 92–93
 sustained-release effect 89–91
- carbon-based 85
- characteristics 84
- composite nanomaterials 87
- magnetic nanomaterials 86–87
- metal-based 84–85
 quantum dots 86
- nucleic acid-based gene therapy 141
- nucleic acid-based nanomaterials (NAN)
 improve stability methods 15
 artificial nucleic acids 17–18
 coating with protective structures 20–22
 construction 26
 covalent crosslinking 22–24
 improve stability 15
 nucleobase/ribose modification 19–20
 phosphate group modification 18–19
 tuning buffer conditions 23, 25
 two-or three-dimensional nanostructures 15
- nucleic acid, description 3
- nucleic acid nanomaterials 123, 139, 141, 150
 advances in endocrine and metabolic diseases 143
 application directions 82
 development of 124, 125
 for diabetes mellitus 144–146
 for nonalcoholic fatty liver disease 148–149
 for obesity 147–148
 for osteoporosis 146–147
 properties and applications
 DNA origami 127–129
 dynamic DNA nanostructure 130–133
 tFNAs 125–127
- nucleic acid nanoparticles, as carriers for OA therapy 194

nucleic acid nanotechnology 82, 83, 124, 139, 141
 nucleic acid sequences 6, 15, 62

o

obesity 139, 140, 147–149, 183
 oral hypoglycemic agents 144
 osteoarthritis (OA) 181
 nucleic acid nanomaterials-based therapy 184
 pathology of 181–182
 risk factors 183
 therapy challenges 183
 vector-dependent 188–194
 vector-independent 184–188
 osteoporosis 81, 91, 93, 146–147
 overcoming drug resistance 43, 51, 52

p

PEG-DNA structure 20
 PEG-protamine-tetrahedral framework DNA (PPT) complex 172
 penicillin-binding proteins (PBPs) 168
 peptide-decorated FNAs 49
 peptide nucleic acids (PNA) 17, 64, 69, 88
 pharmacological therapy 140
 photochemical crosslinking 23
 photodynamic therapy (PDT) 43, 44, 68, 70, 102, 115–116, 123, 127
 photothermal therapy (PTT) 7, 43, 46, 89, 130
 pH-sensitive FNA design 51
 phytochemicals 45, 49, 148
 plasmids 93, 184, 192, 194
 point of care (POC) detection 102
 polymerase chain reaction (PCR) 102, 142
 polymeric DNA-based nanomaterials 2
 proinflammatory chemokine C-C motif-ligand 2 145
 protein-coated DNA origami 20
 protein detection
 antibody-based HCR system 107, 108
 aptamer-based HCR system 108–109
 protein kinase A (PKA) phosphorylates sub-peptide 113

protein tyrosine phosphatase-1B (PTP1B) 146
 proteomic identification method 41

q

quantitative polymerase chain reaction (qPCR) 168
 quantum dots 84, 86, 87, 93, 94, 108

r

recombinase polymerase amplification (RPA) 106, 107
 resveratrol 45
 ribonucleic acid (RNA) 3
 interfering therapy 116

s

scaffold material, for bone regeneration 92–93
 SELEX *in vitro* screening technique 4
 SELEX system 148
 self-assembled 3D FNA nanostructures 7
 self-assembled DNA nanostructure 38
 self-assembled DNA nanotechnology 88
 self-assembled FNAs 40
 self-assembled nucleic acid nanostructures 88
 serine/threonine protein kinase (STK)25 149
 short tube DNA origami (STDO) 21
 single-nucleotide variants (SNV) detection 105–107
 siRNA-templated 3D spherical FNAs 50
 small interfering RNAs (siRNAs) 126
 nucleic acid drugs 141
 vector-dependent nucleic acid nano-materials for OA therapy 188, 192
 small-molecule drugs 41
 antibiotic agents 44–45
 antitumor agents 42–45
 chemotherapeutic drugs 42–43
 phototherapeutic agents 43–44
 phytochemicals 45
 sodium glucose cotransporter-2 (SGLT2) 146

- spherical nucleic acids (SNAs) 91, 148, 149
 stimuli-sensitive FNAs 51
 sub-peptide modified silica nanoparticles 113
 super silver nanoclusters based on branched DNA 164–165
 systematic evolution of ligands by the exponential enrichment (SELEX) process 49
 systemic drug delivery, of gene-related therapeutics 142
- t**
 tensegrity triangle 124
 tetrahedral DNA-based nanomaterials (TDNs) 2, 9
 tetrahedral framework DNA 166
 nucleic acid antibiotics delivery 168–169
 polypeptide antibiotics delivery 169
 traditional antibiotics delivery 168
 tetrahedral framework nucleic acids (tFNAs)
 15, 124, 144, 145
 ampicillin-loaded 44
 angiogenic peptide loaded 15
 aptamer AS1411-modified 41
 aptamers 126
 clindamycin-tFNAs complex 15
 curcumin-loaded 15
 erythromycin-loaded 44
 glioma-specific peptide-modified 49
 HApt 126
 microRNA-155 loaded 15
 nanostructures 88
 nucleic acid nanomaterials 125–127
 tetrahedron-loaded hairpins 113
 TE20-type kinase MST3 149
 3D DNA-based nanomaterials 8, 9
 toehold-mediated strand displacement (TMSD) 103
 “top-down” approach 1
 traditional bone tissue regeneration treatment methods 81
 transferrin 129
 triplex DNA 5–6
 triplex-forming oligonucleotides (TFOs) 5
 tumor cell membrane antigen detection 107
- v**
 vector-dependent nucleic acid nanomaterials,
 for OA therapy 189–191
 cDNA 192
 CircRNA 192, 194
 miRNA mimics 188
 mRNA 192
 small interfering RNA 188, 192
 vector-independent nucleic acid
 nanomaterials, for OA therapy 184
 antisense oligonucleotides 187
 aptamers 187–188
 tFNA
 biodistribution of 185
 therapeutic effect of 184–185, 187
 VicK protein-related gene 168
 vildagliptin 145
 vitamin B12 (VB12) 46
- w**
 wild-type mtRNA (WT-mRNA) 64

