

**Cross Reference Art Collection Class 977  
NANOTECHNOLOGY (April 19, 2005)**

- 7200E**                    **NANOSTRUCTURE**
- 7240D                    . . . Integrated with dissimilar structures on a common substrate
  - 7355C                    . . .     Having biological material component
  - 7356H                    . . . . . Cellular
  - 7357R                    . . . . . Nucleic acids (e.g., DNA or RNA, etc.)
  - 7358W                    . . . . . Protein or peptide
  - 7359T                    . . . . . Carbohydrate
  - 7203Y                    . . .     Having different types of nanoscale structures or devices on a common substrate
  - 7205H                    . . .     With distinct switching device
  - 7360C                    . . . . . Including molecular switching device
  - 7361H                    . . . . .     Biological switching
  - 7362R                    . . . . .     Nucleic acid switching
  - 7222Y                    . . .     Formed from plural layers of nanosized material (e.g., stacked structures, etc.)
  - 7363W                    . . . . . Including lipid layer
  - 7364T                    . . . . .     Containing protein
  - 7366N                    . . .     On an organic substrate
  - 7365E                    . . . . . Biological cell surface
  - 7367D                    . . . . . Lipid substrate
  - 7468Y                    . . . . . Carbohydrate substrate
  - 7369C                    . . . . . Nucleic acid substrate
  - 7242C                    . . .     On an electrically conducting, semiconducting, or semi-insulating substrate
  - 7243H                    . . . . . On a silicon substrate
  - 7244R                    . . . . . On a metal substrate
  - 7245W                    . . .     On an electrically insulating substrate
  - 7206R                    . . .     Devices having flexible or movable element
  - 7235D                    . . .     Nanomotor/nanoactuator
  - 7236Y                    . . . . . Using chemical reaction/biological energy (e.g. ATP, etc.)
  - 7207W                    . . .     Formed from biological material
  - 7227T                    . . . . . Nucleic acids (e.g., DNA or RNA, etc.)
  - 7208T                    . . . . . From protein or unit thereof (e.g., enzyme or carboxyl group, etc.)
  - 7209E                    . . . . . For electrical purposes
  - 7210H                    . . .     Formed from a single atom, molecule, or cluster
  - 7211R                    . . .     Nanocantilever
  - 7246T                    . . .     Nanodiaphragm
  - 7135N                    . . .     Fullerenes (i.e., graphene-based structures, e.g., nanohorns, nanococoons, nanoscrolls, etc.) or Fullerene-like structures (e.g., WS<sub>2</sub> or MoS<sub>2</sub> chalcogenide nanotubes, planar C<sub>3</sub>N<sub>4</sub>, etc.)
  - 7248N                    . . .     Carbon buckyball (C<sub>60</sub>, C<sub>70</sub>, etc., and derivatives and modifications thereof)
  - 7249D                    . . . . . Having atoms interior to the carbon cage
  - 7250W                    . . . . . Having a modified surface
  - 7251T                    . . . . .     Modified with biological, organic, or hydrocarbon material
  - 7371N                    . . . . .     Modified with an enzyme
  - 7252E                    . . . . .     Modified with atoms or molecules bonded to the surface
  - 7253N                    . . . . .     Modified with dissimilar atom or molecule substituted for carbon atoms of the buckyball (e.g., impurity doping or compositional substitution, etc.):
  - 7216D                    . . .     Carbon nanotubes (CNTs)
  - 7254D                    . . . . . Having specified tube end structure (e.g., close-ended shell or open-ended tube, etc.)
  - 7258R                    . . . . . Having atoms interior to the carbon cage
  - 7259W                    . . . . . Having a modified surface
  - 7260Y                    . . . . .     Modified with biological, organic, or hydrocarbon material
  - 7372D                    . . . . .     Modified with an enzyme
  - 7261C                    . . . . .     Modified with atoms or molecules bonded to the surface
  - 7262H                    . . . . .     Modified with dissimilar atoms or molecules substituted for carbon atoms of the CNT (e.g., impurity doping or compositional substitution, etc.)

- 7255Y . . . Single-walled
- 7256C . . . With specified chirality and/or electrical conductivity (e.g., chirality of (5,4), (5,5), (10,5), etc.)
- 7257H . . . Multi-walled
- 7218C . . With polymeric or organic binder
- 7220N . Dendrimer (i.e., serially-branching or “tree-like” structure)
- 7086T . Nanosheet or quantum barrier/well (i.e., layer structure having one dimension or thickness of 100 nm or less)
- 7373H . . . Lipid layer
- 7374C . . . Layer containing protein
- 7263R . . Mono-atomic layer or  $\delta$ -doped (delta-doped) sheet
- 7264W . . Quantum well dimensioned for intersubband transitions (e.g., for use in unipolar light emitters or quantum well infrared photodetectors)
- 7265T . . Superlattice with graded effective bandgap (e.g., “CHIRP-graded” superlattice, etc.)
- 7266E . . Superlattice with well or barrier thickness adapted for increasing the reflection, transmission, or filtering of carriers having energies above the bulk-form conduction or valence band energy level of the well or barrier (i.e., well or barrier with  $n_{\text{integer}}\lambda_{\text{carrier}}/4$  thickness)
- 7237C . Nanowire or quantum wire (axially elongated structure having two dimensions of 100 nm or less)
- 7269Y . . Formed along or from crystallographic terraces or ridges
- 7270T . . With specified packing density
- 7123Y . . With specified cross-sectional profile (e.g., belt-shaped, etc.)
- 7271E . . Bent wire (i.e., having nonlinear longitudinal axis)
- 7375H . . . Mesh structure
- 7272N . . . Helical wire
- 7376R . . . . Formed with nucleic acid
- 7377W . . . . Formed with polyamide polymers
- 7273D . . . Nanoring
- 7378T . . . . Formed from circular biomolecule (e.g., DNA, heme, chelators, etc.)
- 7085W . Nanoparticle (structure having three dimensions of 100 nm or less)
- 7274Y . . Exhibiting three-dimensional carrier confinement (e.g., quantum dots, etc.)
- 7090W . . Nanosized powder or flake (e.g., nanosized catalyst, etc.)
- 7091T . . . Ceramic powder or flake
- 7092E . . . Metallic powder or flake
- 7076Y . Within specified host or matrix material (e.g., nanocomposite films, etc.)
- 7225R . . Possessing nanosized particles, powders, flakes or clusters other than simple atomic impurity doping
- 7275C . . Possessing fully-enclosed nanosized voids or physical holes
- 7223C . . Possessing nanosized surface openings that extend partially into or completely through the host material
- 7224H . . Possessing nanosized physical convexity, ridge or protrusion extending upward from the host’s surface
- 7379E . . Biological host/matrix (e.g., lipid, etc.)
- 7277R . . Electrically conducting, semi-conducting, or semi-insulating host material
- 7278W . . Electrically insulating host material
- 7380H . . Fluidic host/matrix containing nanomaterials
- 7381R . . . Colloidal fluid
- 7382W . . . . Biological nanomaterial
- 7383T . . . Viscous fluid
- 7215N . . Of specified organic or carbon-based composition
- 7384E . . In array format
- 7385N . . . With heterogeneous nanostructures
- 7386D . . . . Molecular array
- 7387Y . . . . . Nucleic acid array (e.g, human genome array, etc.)
- 7388C . . . . . Protein array
- 7389H . . . . . Chemical library array

- 7213T . . . Composed of biological material
- 7214E . . . . For electrical or electronic purpose
- 7390N . . . Lipid particle
- 7391D . . . . Having internalized material
- 7392Y . . . . . Containing biological material
- 7393C . . . . . Nucleic acid (e.g., DNA or RNA, etc.)
- 7394H . . . . . Drug
- 7395R . . . Virus based particle
- 7396W . . . . Containing biological material in its interior
- 7397T . . . . . Containing nucleic acid
- 7398E . . . . . Containing drug
- 7399N . . . . With exterior chemical attachment
- 7400D . . . . . Exterior attachment for detection
- 7401Y . . . . . Exterior attachment for targeting (e.g., drug targeting, etc.)
- 7078H . . . Organic film on silicon
- 7284T . . . Of specified metal or metal alloy composition
- 7285E . . . Of specified metal oxide composition (e.g., conducting or semiconducting compositions such as ITO, ZnOx, etc.)
- 7286N . . . Perovskites and superconducting compositions (e.g. Ba<sub>x</sub>Sr<sub>1-x</sub>TiO<sub>3</sub>, etc.)
- 7084R . . . Of specified inorganic semiconductor composition (e.g., periodic table group IV-VI compositions, etc.)
- 7287D . . . Group IV based elements and compounds (e.g., C<sub>x</sub>Si<sub>y</sub>Ge<sub>z</sub>, etc.)
- 7288Y . . . Group III-V based compounds (e.g., Al<sub>a</sub>Ga<sub>b</sub>In<sub>c</sub>N<sub>x</sub>P<sub>y</sub>As<sub>z</sub>, etc.)
- 7289C . . . . III-N based compounds (e.g., Al<sub>x</sub>Ga<sub>y</sub>In<sub>z</sub>N, etc.)
- 7290E . . . . . High-indium-content InGaN pooling or clusters
- 7291N . . . . III-P based compounds (e.g., Al<sub>x</sub>Ga<sub>y</sub>In<sub>z</sub>P, etc.)
- 7292D . . . . III-As based compounds (e.g., Al<sub>x</sub>Ga<sub>y</sub>In<sub>z</sub>As, etc.)
- 7293Y . . . . III-Sb based compounds (e.g., Al<sub>x</sub>Ga<sub>y</sub>In<sub>z</sub>Sb, etc.)
- 7294C . . . . Mixed group V compounds (e.g., III-N<sub>x</sub>P<sub>y</sub>, etc.)
- 7295H . . . . . Boron-containing compounds
- 7296R . . . . . Tl-containing or Bi-containing compounds
- 7297W . . . . Group II-VI nonoxide compounds (e.g., Cd<sub>x</sub>Mn<sub>y</sub>Te, etc.)
- 7298T . . . Heterojunction formed between semiconductor materials that differ in that they belong to different periodic table groups (e.g., Ge (Group IV) - GaAs (Group III-V) or InP (group III-V) - CdTe (Group II-VI), etc.)
- 7299E . . . . Nonstoichiometric semiconductor compounds (e.g., III<sub>x</sub>V<sub>y</sub>; x ≠ y, etc.)
- 7088N . . . Formed from hybrid organic/inorganic semiconductor compositions
- 7150R . . . . Biological composition interconnected with inorganic material
- 7151W . . . . Organic or biological core coated with inorganic shell
- 7152T . . . . Inorganic core or cluster coated with organic or biological shell
- 7153E . . . . Of specified ceramic or electrically insulating compositions
- 7154N . . . . Having specified property (e.g., lattice-constant, thermal expansion coefficient, etc.)
- 7331T . . . Thermal property of nanomaterial (e.g., thermally conducting/insulating or exhibiting Peltier or Seebeck effect, etc.)
- 7332E . . . Optical properties of nanomaterial (e.g. specified transparency, opacity, or index of refraction, etc.)
- 7333N . . . Chemical or nuclear reactivity/stability of composition or compound forming nanomaterial
- 7402C . . . . Having biological reactive capability
- 7155D . . . Piezoelectric property of nanomaterial
- 7156Y . . . Magnetic property of nanomaterial

**7226W MATHEMATICAL ALGORITHMS, E.G., COMPUTER SOFTWARE, ETC., SPECIFICALLY ADAPTED FOR MODELING CONFIGURATIONS OR PROPERTIES OF NANOSTRUCTURE**

**7300N MANUFACTURE, TREATMENT, OR DETECTION OF NANOSTRUCTURE**

- 7301D . Environmental containment or disposal of nanostructure material
- 7345T . For carbon nanotubes or fullerenes
- 7347N . . Gas phase catalytic growth (i.e., chemical vapor deposition)
- 7348D . . Growth by vaporization or dissociation of carbon source using a high-energy heat source (e.g., electric arc, laser, plasma, e-beam, etc.)
- 7349Y . . Purification or separation of fullerenes or nanotubes
- 7350T . . Internal modifications (e.g., filling, endohedral modifications, etc.)
- 7351E . . Surface modifications (e.g., functionalization, coating, etc.)
- 7352N . . Tube end modifications (e.g., capping, joining, splicing, etc.)
- 7100T . With scanning probe
- 7101E . . Scanning probe control process
- 7104Y . . . Particular movement or positioning of Scanning tip
- 7105C . . For detection of specific nanostructure sample or nanostructure-related property
- 7125H . . . biological sample
- 7126R . . . semiconductor sample
- 7106H . . For manufacture of nanostructure
- 7107R . . . Including etching/cutting
- 7108W . . . Including coating
- 7109T . . . Including positioning/mounting nanostructure
- 7110C . . . Including substrate treatment
- 7112R . . Scanning probe structure
- 7127W . . . Scanning tunneling probe
- 7128T . . . Near-field probe
- 7129E . . . Atomic force probe
- 7130H . . . Electrostatic force probe
- 7131R . . . Magnetic force probe
- 7132W . . . Scanning capacitance probe
- 7133T . . . Scanning thermal probe
- 7114T . . . With optical means
- 7134E . . . . Optical microscope
- 7157C . . . . Optical lever arm for reflecting light
- 7158H . . . . With environmental regulation means
- 7159R . . . Positioner
- 7160D . . . Tip holder
- 7116H . . . Probe tip array
- 7118Y . . . With tip detail
- 7117D . . . . Nanotube tip
- 7119C . . . . Chemically functionalized
- 7120E . . . . Shape/taper
- 7121N . . . . Material
- 7303C . With arrangement, process, or apparatus for testing
- 7316Y . . Microscopy or spectroscopy (e.g., SEM, TEM, etc.)
- 7304H . Assembling of separate components (e.g., by attaching, etc.)
- 7353D . . Fluidic self-assembly (“FSA”)
- 7403H . . Assembled via biorecognition entity
- 7404R . . . Via nucleic acid hybridization
- 7405W . . . Via protein recognition
- 7354Y . Nanoimprint lithography (i.e., nanostamp)
- 7305R . Shaping or removal of materials (e.g., etching, etc.)
- 7306W . . By laser ablation
- 7313E . Deposition of materials (e.g., coating, CVD, or ALD, etc.)
- 7319R . . Vapor phase deposition
- 7320D . . Liquid phase deposition
- 7406T . . Deposition in pores (molding) with subsequent removal of mold
- 7307T . Having step or means utilizing biological growth

- 7308E . Having step or means utilizing chemical property
- 7309N . . Chemical synthesis (e.g. chemical bonding or breaking, etc.)
- 7407E . . . Polymerization
- 7310R . . . Enzymatic
- 7311W . . . Electrolytic
- 7314N . Having step or means utilizing mechanical or thermal property (e.g., pressure, heat, etc.)
- 7315D . Having step or means utilizing electromagnetic property (e.g., optical, x-ray, electron beam, etc.)

**7140N SPECIFIED USE OF NANOSTRUCTURE**

- 7302Y . Use of nanostructure for conversion, containment, or destruction of environmentally hazardous material
- 7001T . For medical, immunological, body treatment, or diagnosis
- 7202D . . . Specially adapted for travel through blood circulatory system
- 7335Y . . Drug delivery
- 7336C . . . Liposome
- 7408N . . Mechanical repair performed/surgical
- 7409D . . . Obstruction removal
- 7410W . . . Strengthening cell or tissue
- 7411T . . . Cancer cell destruction
- 7412E . . . Cancer cell repair
- 7413N . . . Stem cell therapy implantation
- 7338R . . Protein engineering
- 7075D . . Therapeutic or pharmaceutical composition
- 7339W . . . Gene therapy
- 7340Y . . . Vaccine
- 7006C . . Immunological
- 7141D . . Dental
- 7009W . . Detection of biochemical
- 7414D . . . Of toxic chemical
- 7415Y . . . Of explosive material
- 7238H . . Cell culture
- 7239R . . Using nanostructure as support of DNA analysis
- 7002E . . Bioelectrical
- 7012H . . Topical chemical (e.g., cosmetic or sunscreen, etc.)
- 7013R . . Diagnostic contrast agent
- 7416C . . . X-ray agent
- 7417H . . . Ultrasound contrast agent
- 7418R . . . MRI contrast agent
- 7014W . . Medical device coating
- 7161Y . For electronic or optoelectronic application
- 7165W . . Spintronics or quantum computing
- 7179W . . . Giant magnetoresistance (GMR)
- 7180Y . . . Spin dependent tunnel (SDT) junction (e.g., tunneling magnetoresistance (TMR), etc.)
- 7164R . . Single electron transistor
- 7162C . . Nanoelectronic circuit or nanocircuit element
- 7163H . . . Logic circuit
- 7419W . . . . DNA computation
- 7420Y . . . . Protein computation
- 7166T . . Information storage or retrieval using nanostructure
- 7421C . . . Biochemical memory
- 7422H . . . . Protein memory
- 7423R . . . . Nucleic acid memory
- 7167E . . . With scanning probe instrument
- 7168N . . Radiation emitter using nanostructure
- 7169D . . . Electromagnetic energy
- 7170W . . . . Laser

7171T . . . Electron emitter  
7172E . . Display  
7173N . . Detector using nanostructure  
7174D . . . Of mechanical property  
7175Y . . . Of chemical property or presence  
7424W . . . . Of biomolecule property  
7425T . . . . . Of disease state  
7176C . . . Of thermal property  
7177H . . . Of electrical property  
7178R . . . Of magnetic property  
7181C . . . Of radiant energy  
7182H . . Energy storage/generating using nanostructure (e.g., fuel cell, battery, etc.)  
7142Y . . For textile or fabric treatment  
7035E . . For carrying or transporting  
7600C **MISCELLANEOUS**

Please send any comments or questions to

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