|  |  |
| --- | --- |
| **General Attributes** |  |
| 1.  Malleability | 2.  Polymorphism |
| 3. Ductility | 4.  Surface topology |
| 5. Lustrous | 6.  Structural bond forces |
| 7. Softness | 8.  Ionic distribution |
| 9. Durability | 10.  Dielectric relaxation |
| 11. Molecular weight | 12.  Stiffness |
| 13. Resistance to oxidation | 14.  Capacitance stability |
| 15. Resistance to corrosion | 16.  Granularity |
| 17. Conductivity of electricity | 18.  Dimensional stability |
| 19.  Surface Plasmon resonance | 20.  Transparency |
| 21.  Chemical reactivity | 22.  Power loss factor |
| 23.  Colour | 24.  Point adhesion |
| 25.  Internal reflection | 26.  Magnetic ordering |
| 27.  Phase | 28.  Resistance to deformation |
| 29.  Capable of transmitting light | 30.  Specific surface area |
| 31.  Index of refraction | 32.  Crystallite size |
| 33.  Lubricity | 34.  Crystal phase |
| 35.  Strength | 36.  Reaction rate |
| 37.  Resistance to neutron radiation | 38.  Catalytic selectivity |
| 39.  Rigidity | 40.  Debye wall factor |
| 41.  Wear resistance | 42.  BENS broadening |
| 43.  Biocompatibility | 44.  Fragility |
| 45.  Film friction coefficient | 46.  Current density |
| 47.  Impact sensitive | 48.  Resistance to arcing |
| 49.  Toughness | 50.  Orbit hybridization |
| 51.  Dispersion | 52.  Metallic behaviour |
| 53.  Reinforcement | 54.  Aspect ratio |
| 55.  Stability | 56.  Radial elasticity |
| 57.  Solubility | 58.  Symmetry |
| 59.  Brittleness | 60.  Polarizability |
| 61.  Resistance to high temperature | 62.  Taper ratio |
| 63.  Strengthening | 64.  Light weight |
| 65.  Substrate | 66.  Ballistic resistance capacity |
| 67.  Relative chemical inertia | 68.  Toxicity |
| 69.  Robustness | 70.  Angle of incidence |
| 71.  Monoclinic | 72.  Electromagnetic resonance |
| 73.  Dielectric breakdown | 74.  Crystal structure |
| 75.  Resistance to cracking | 76.  Thermo ionic |
|  | 77 Work function |
| **Physical Attributes** |  |
| 78.Density | 79.  Platy |
| 80.True density | 81.  Specific suspension  |
| 82.Melting point | 83.  Resilience |
| 84.Boling point | 85.  Bulk density |
| 86.Heat of fusion | 87.  Decomposition temperature |
| 88.Heat of vaporization | 89.  Threshold electric field |
| 90. Molar heat capacity | 91.  Binding energies |
| 92. Lattice constant | 93.  Catalyst |
| 94. Metallic radius | 95.  Curvature energies |
| 96.  Gas solid liquid | 97.  String tension |
| 98.  Wavelength | 99.  Diameter |
| 100.  Morphology | 101.  Particle size |
| 102. Bond distance | 103.  Emissivity |
| 104.  Purity | 105.  Richard constant |
| 106.  Molar density | 107.  Hardness |
| 108.  Dielectric | 109.  Length |
| 110.  Hydrophilic | 111.  Brightness |
|  | 112. Short term beam stability |
| **Mechanical Attributes** |  |
| 113.Tensile strength | 114.  Compression yield strength |
| 115. Young’s modulus | 116.  Coefficient of friction |
| 117. Shear modulus | 118.  Flexural strength |
| 119. Bulk modulus | 120.  Percentage elongation |
| 121. Poisson’s ratio | 122.  Impact strength |
| 123. Mohr hardness | 124.  Deformation stress |
| 125. Vickers hardness | 126.  Van der wall forces |
| 127. Brinell hardness | 128.  Internal surface area |
| 129.  Knoop hardness | 130.  Specific strength |
|  | 131.  Fracture toughness |
| **Atomic Attributes** |  |
| 132.Oxidation states | 133.Atomic radius |
| 134.Electro-negativity | 135.Covalent radius |
| 136 Ionization energies | 137.Van der wall radius |
| **Electrical Attributes** |  |
| 138. Electrical resistivity | 139. Electrical performance |
| 140. Dielectric constant | 141. Superconductivity |
| 142. Dielectric strength | 143. Conductance quantization |
| 144. Band structure | 145. Band gap |
| 146. Curvature effects | 147. Electrical conductivity |

|  |  |
| --- | --- |
| **Thermal Attributes** |  |
| 148. Thermal conductivity | 149.  Thermal stability |
| 150. Thermal expansion | 151.  Thermal source |
| 152. Specific heat | 153.  Coefficient of thermal expansion |
| 154. Temperature | 155.  Ballistic conductance |
| 156.  Standard entropy | 157.  Temperature stability |
| 158.  Standard enthalpy of formation | 159.  Phonon mean free path |
| 160.  Nucleation | 161.  Relaxation time |
| **Optical Attributes** |  |
| 162.  Transmission | 163.  Absorption |
| 164.  Luminescence | 165.  Photo-luminescence |
| 166.  Index of refraction | 167.  Surface Plasmon |
|  | 168.  Oscillation |

Table-1 list of broad categories attributes of nanomaterial

|  |  |
| --- | --- |
| **Specific surface area in cm2/g** | **Code** |
| Up to 25 cm2/g | 0 |
| 50 cm2/g | 1 |
| 100 cm2/g | 2 |
| 150 cm2/g | 3 |
| 200 cm2/g | 4 |
| 250 cm2/g and above  | 5 |

Table-2 coding of specific surface area of nanomaterial

|  |  |
| --- | --- |
| **Tensile strength in GPa** | **Code** |
| Up to 10 GPa | 0 |
| 20 GPa | 1 |
| 30 GPa | 2 |
| 40 GPa | 3 |
| 50 GPa | 4 |
| 60 GPa and above  | 5 |

Table-3 coding of tensile strength of nanomaterial

|  |  |
| --- | --- |
| **Magnetic ordering** | **Code** |
| Not available  | 0 |
| Magnetic | 1 |
| Diamagnetic | 2 |
| Paramagnetic | 3 |

Table-4 coding of magnetic ordering of nanomaterial

|  |  |
| --- | --- |
| **Morphology**  | **Code** |
| Cubic | 0 |
| Body centred cubic | 1 |
| Face centred cubic | 2 |
| Cylindrical | 3 |
| Tubular  | 4 |
| Pseudo hexagonal | 5 |

Table-5 coding of morphology of nanomaterial

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **General** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|  | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|  | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 |
|  | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
|  | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 |
|  | 76 | 77 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Physical** | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 |
|  | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 |
|  | 108 | 109 | 110 | 111 | 112 |  |  |  |  |  |  |  |  |  |  |
| **Mechanical** | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 |
|  | 128 | 129 | 130 | 131 |  |  |  |  |  |  |  |  |  |  |  |
| **Atomic** | 132 | 133 | 134 | 135 | 136 | 137 |  |  |  |  |  |  |  |  |  |
| **Electrical** | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 |  |  |  |  |  |
| **Thermal** | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 |  |
| **Optical** | 162 | 163 | 164 | 165 | 166 | 167 | 168 |  |  |  |  |  |  |  |  |

Table-6 168-digit coding scheme for characterization of nanomaterial

|  |  |  |  |
| --- | --- | --- | --- |
| **S/No** | **Attributes** | **Information** | **Code** |
| 1 | Malleability | - | 0 |
| 2 | Polymorphism | None | N |
| 3 | Ductility | - | 0 |
| 4 | Surface topology | - | 0 |
| 5 | Lustrous | - | 0 |
| 6 | Structural bond forces | - | 0 |
| 7 | Softness | - | 0 |
| 8 | Ionic distribution | - | 0 |
| 9 | Durability | - | 0 |
| 10 | Dielectric relaxation | - | 0 |
| 11 | Molecular weight | - | 0 |
| 12 | Stiffness | - | 0 |
| 13 | Resistance to oxidation | - | 0 |
| 14 | Capacitance stability | - | 0 |
| 15 | Resistance to corrosion | - | 0 |
| 16 | Granularity | - | 0 |
| 17 | Conductivity of electricity | - | 0 |
| 18 | Dimensional stability | Stable | 4 |
| 19 | Surface Plasmon resonance | - | 0 |
| 20 | Transparency | - | 0 |
| 21 | Chemical reactivity | - | 0 |
| 22 | Power loss factor | - | 0 |
| 23 | Colour | Black | B |
| 24 | Point adhesion | - | 0 |
| 25 | Internal reflection | - | 0 |
| 26 | Magnetic ordering | Diamagnetic | D |
| 27 | Phase | - | 0 |
| 28 | Resistance to deformation | - | 0 |
| 29 | Capable of transmitting light | - | 0 |
| 30 | Specific surface area | 290 m2/g | 5 |
| 31 | Index of refraction | - | 0 |
| 32 | Crystallite size | - | 0 |
| 33 | Lubricity | - | 0 |
| 34 | Crystal phase | Specific Phase Amorphous Highly Crystalline | A |
| 35 | Strength | - | 0 |
| 36 | Reaction rate | - | 0 |
| 37 | Resistance to neutron radiation | - | 0 |
| 38 | Catalytic selectivity | - | 0 |
| 39 | Rigidity | - | 0 |
| 40 | Debye wall factor | - | 0 |
| 41 | Wear resistance | - | 0 |
| 42 | BENS broadening | - | 0 |
| 43 | Biocompatibility | - | 0 |
| 44 | Fragility | - | 0 |
| 45 | Film friction coefficient | - | 0 |
| 46 | Current density | >3.2x109A/cm2 | 5 |
| 47 | Impact sensitive | - | 0 |
| 48 | Resistance to arcing | - | 0 |
| 49 | Toughness | - | 0 |
| 50 | Orbit hybridization | - | 0 |
| 51 | Dispersion | Customised/Soluble in Organic Solvents on high shearing/Sonication | 3 |
| 52 | Metallic behaviour | - | 0 |
| 53 | Reinforcement | - | 0 |
| 54 | Aspect ratio | ~1000 | 5 |
| 55 | Stability | Stable | S |
| 56 | Radial elasticity | - | 0 |
| 57 | Solubility | Insoluable | IS |
| 58 | Symmetry | - | 0 |
| 59 | Brittleness | - | 0 |
| 60 | Polarizability | - | 0 |
| 61 | Resistance to high temperature | - | 0 |
| 62 | Taper ratio | - | 0 |
| 63 | Strengthening | - | 0 |
| 64 | Light weight | - | 0 |
| 65 | Substrate | - | 0 |
| 66 | Ballistic resistance capacity | - | 0 |
| 67 | Relative chemical inertia | - | 0 |
| 68 | Toxicity | - | 0 |
| 69 | Robustness | - | 0 |
| 70 | Angle of incidence | Amorphous highly Crystalline | 5 |
| 71 | Monoclinic | - | 0 |
| 72 | Electromagnetic resonance | - | 0 |
| 73 | Dielectric breakdown | - | 0 |
| 74 | Crystal structure | - | 0 |
| 75 | Resistance to cracking | - | 0 |
| 76 | Thermo ionic | - | 0 |
| 77 | Work function | - | 0 |
| 78 | Density | - | 0 |
| 79 | Platy | - | 0 |
| 80 | True density | ~2.1g/cm3 | 4 |
| 81 | Specific suspension  | Dispersions in Organic Solvents, Water | W |
| 82 | Melting point | 3652-3697 Degree C | 5 |
| 83 | Resilience | - | 0 |
| 84 | Boling point | - | 0 |
| 85 | Bulk density | 0.20g/cm3 | 5 |
| 86 | Heat of fusion | - | 0 |
| 87 | Decomposition temperature | - | 0 |
| 88 | Heat of vaporization | - | 0 |
| 89 | Threshold electric field | - | 0 |
| 90 | Molar heat capacity | - | 0 |
| 91 | Binding energies | - | 0 |
| 92 | Lattice constant | - | 0 |
| 93 | Catalyst | Slight Impurities < 5% Trace catalyst | 3 |
| 94 | Metallic radius | - | 0 |
| 95 | Curvature energies | - | 0 |
| 96 | Gas solid liquid | Physical State Solid Amorphous Powder | P |
| 97 | String tension | - | 0 |
| 98 | Wavelength | - | 0 |
| 99 | Diameter | Average Outer Diametre12nm, Average Inner Diameter 8nm | 5 |
| 100 | Morphology | Seamless and Fracture less Tubular Structure | T |
| 101 | Particle size | - | 0 |
| 102 | Bond distance | - | 0 |
| 103 | Emissivity | - | 0 |
| 104 | Purity | >95% by weight | 4 |
| 105 | Richard constant | - | 0 |
| 106 | Molar density | - | 0 |
| 107 | Hardness | - | 0 |
| 108 | Dielectric | - | 0 |
| 109 | Length | 4-5 micrometer | 4 |
| 110 | Hydrophilic | - | 0 |
| 111 | Brightness | - | 0 |
| 112 | Short term beam stability | - | 0 |
| 113 | Tensile strength | >55GPa | 4 |
| 114 | Compression yield strength | - | 0 |
| 115 | Young’s modulus | 107 GPa | 5 |
| 116 | Coefficient of friction | - | 0 |
| 117 | Shear modulus | - | 0 |
| 118 | Flexural strength | - | 0 |
| 119 | Bulk modulus | - | 0 |
| 120 | Percentage elongation | - | 0 |
| 121 | Poisson’s ratio | - | 0 |
| 122 | Impact strength | - | 0 |
| 123 | Mohr hardness | - | 0 |
| 124 | Deformation stress | - | 0 |
| 125 | Vickers hardness | - | 0 |
| 126 | Van der wall forces | 0.2cm | 2 |
| 127 | Brinell hardness | - | 0 |
| 128 | Internal surface area | - | 0 |
| 129 | Knoop hardness | - | 0 |
| 130 | Specific strength | - | 0 |
| 131 | Fracture toughness | - | 0 |
| 132 | Oxidation states | - | 0 |
| 133 | Atomic radius | - | 0 |
| 134 | Electro-negativity | - | 0 |
| 135 | Covalent radius | - | 0 |
| 136 | Ionization energies | - | 0 |
| 137 | Van der wall radius | - | 0 |
| 138 | Electrical resistivity | - | 0 |
| 139 | Electrical performance | Conducting | C |
| 140 | Dielectric constant | - | 0 |
| 141 | Superconductivity | - | 0 |
| 142 | Dielectric strength | - | 0 |
| 143 | Conductance quantization | - | 0 |
| 144 | Band structure | - | 0 |
| 145 | Band gap | - | 0 |
| 146 | Curvature effects | - | 0 |
| 147 | Electrical conductivity | >100 Simens/cm (Along Tube Axis) | 5 |
| 148 | Thermal conductivity | >3000 w/m/k (Along Tube Axis) | 5 |
| 149 | Thermal stability | - | 0 |
| 150 | Thermal expansion | - | 0 |
| 151 | Thermal source | - | 0 |
| 152 | Specific heat | - | 0 |
| 153 | Coefficient of thermal expansion | - | 0 |
| 154 | Temperature | - | 0 |
| 155 | Ballistic conductance | - | 0 |
| 156 | Standard entropy | - | 0 |
| 157 | Temperature stability | 2800 Degree C in Vaccum and 780 Degree C in Air | 4 |
| 158 | Standard enthalpy of formation | - | 0 |
| 159 | Phonon mean free path | - | 0 |
| 160 | Nucleation | - | 0 |
| 161 | Relaxation time | - | 0 |
| 162 | Transmission | - | 0 |
| 163 | Absorption | - | 0 |
| 164 | Luminescence | - | 0 |
| 165 | Photo-luminescence | - | 0 |
| 166 | Index of refraction | - | 0 |
| 167 | Surface Plasmon | - | 0 |
| 168 | Oscillation | - | 0 |

Table-7 coding scheme for standard nanomaterial ‘Q Tubes® 250’

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **General** | 0 | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|  | 0 | 0 | 4 | 0 | 0 | 0 | 0 | B | 0 | 0 | D | 0 | 0 | 0 | 5 |
|  | 0 | 0 | 0 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|  | 5 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 5 | S | 0 | IS | 0 | 0 | 0 |
|  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
|  | 0 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Physical** | 0 | 0 | 4 | W | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|  | 3 | 0 | 0 | P | 0 | 0 | 5 | T | 0 | 0 | 0 | 4 | 0 | 0 | 0 |
|  | 0 | 4 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |  |  |
| **Mechanical** | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
|  | 0 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |  |  |  |
| **Atomic** | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |  |
| **Electrical** | 0 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |  |  |  |  |  |
| **Thermal** | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |  |
| **Optical** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |  |  |  |  |  |  |  |

Table-8 representation of coding scheme for standard nanomaterial ‘Q Tubes® 250’

|  |  |  |
| --- | --- | --- |
| **S/No** | **List of Nanomaterials** | **References** |
| 1 | QSI-Nano® Manganese  | [***www.qsinano.com***](http://www.qsinano.com) |
| 2 | QSI-Nano® Manganese Dioxide Powder | [***www.qsinano.com***](http://www.qsinano.com) |
| 3 | QSI-Nano® Nickel  | [***www.qsinano.com***](http://www.qsinano.com) |
| 4 | AZ PurifiersTM  | [***www.enginecontrolsystems.com***](http://www.enginecontrolsystems.com) |
| 5 | QSI-Nano® Nickel Oxide Powder | [***www.qsinano.com***](http://www.qsinano.com) |
| 6 | QSI-Nano® Silver Powder | [***www.qsinano.com***](http://www.qsinano.com) |
| 7 | AgNW-60 | [***www.seashelltech.com***](http://www.seashelltech.com) |
| 8 | QSI-Nano® Silver  | [***www.qsinano.com***](http://www.qsinano.com) |
| 9 | ThermoSafe Insulated Shipper-VIP | [***www.nanopore.com***](http://www.nanopore.com) |
| 10 | BioPureTM Gold Nanoparticles (AUPB) | [***www.nanocomposix.com***](http://www.nanocomposix.com) |
| 11 | QSI-Nano® Copper | [***www.qsinano.com***](http://www.qsinano.com) |
| 12 | NanoPoreTM HP | [***www.nanopore.com***](http://www.nanopore.com) |
| 13 | AgNW115 | [***www.seashelltech.com***](http://www.seashelltech.com) |
| 14 | NanoXactTM AU Nanoparticles | [***www.nanocomposix.com***](http://www.nanocomposix.com) |
| 15 | QGraphene® - 50 | [***www.quantum-materials.in***](http://www.quantum-materials.in) |
|  16 | AgNW-115-E  | [***www.seashelltech.com***](http://www.seashelltech.com) |
| 17 | DMSX-II Add-on Silencer | ***enginecontrolsystems.com*** |
| 18 | Citrate NanoXactTM Gold | [***www.nanocomposix.com***](http://www.nanocomposix.com) |
| 19 | Tannic NanoXactTM Gold | [***www.nanocomposix.com***](http://www.nanocomposix.com) |
| 20 | MERV-15 Cartridge | ***Clark Filter Clarcor Company*** |
| 21 | PurimufflersTM | [***www.enginecontrolsystems.com***](http://www.enginecontrolsystems.com) |
| 22 | QSI-Nano® Copper Powder  | [***www.qsinano.com***](http://www.qsinano.com) |
| 23 | QSI-Nano® Copper Oxide Powder | [***www.qsinano.com***](http://www.qsinano.com) |
| 24 | NanoPoreTM HT  | [***www.nanopore.com***](http://www.nanopore.com) |
| 25 | QSI-Nano® Iron | [***www.QSINANO.com***](http://www.QSINANO.com) |
| 26 | Tannic BioPureTM Gold | [***www.nanocomposix.com***](http://www.nanocomposix.com) |
| 27 | QSI-Nano® Iron Oxide Powder | [***www.QSINANO.com***](http://www.QSINANO.com) |
| 28 | QSI-Nano® Silver | [***www.qsinano.com***](http://www.qsinano.com) |
| 29 | AgNW60 | [***www.seashelltech.com***](http://www.seashelltech.com) |
| 30 | NanoPore™ HP-150 | [***www.nanopore.com***](http://www.nanopore.com) |
| 31 | Q Tubes® 250 | ***www.quantum-materials.in*** |

Table-9.list of standard nanomaterials

|  |  |
| --- | --- |
| Specific surface area |  Minimum 110m2/g |
| Young's modulus |  within 83-126 GPa |
| Thermal conductivity |  2483W/m/K |
| Tensile strength |  55GPa |
| Aspect ratio  |  ~1000 |
| Metallic behaviour |  it should be metallic in nature |
| Wear Resistance |  Better wear resistance |

Table-10 minimum requirements of application

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Alternate Nanomaterial** | **Specific surface area** | **Young's modulus** | **Thermal conductivity** | **Tensile strength** | **Aspect ratio** |
|  | **g/cm3** | **GPa** | **W/m-K** | **GPa** |  |
| AgNW115 | 193 | 79 | 2850 | 12 | 205 |
| NanoXactTMAU Nanoparticles | 212 | 910 | 1870 | 15 | 71 |
| QGraphene® - 50 | 160 | 1020 | 2520 | 26 | 1000 |
| QSI-Nano® Silver | 189 | 411 | 2730 | 62 | 58 |
| AgNW60 | 280 | 60 | 2509 | 50 | 70 |
| NanoPore™ HP-150 | 256 | 168 | 1705 | 34 | 150 |
| Q Tubes® 250 | 290 | 107 | 3000 | 55 | 1000 |

Table-11 attributes for short listed candidate nanomaterial

|  |  |
| --- | --- |
| S\*1 = 0.2171  | S‾1 = 0.0527 |
| S\*2 = 0.1893 | S‾2 = 0.1197 |
| S\*3 = 0.0916  | S‾3 = 0.2069 |
| S\*4 = 0.1752  | S‾4 = 0.1304 |
| S\*5 = 0.2032  | S‾5 = 0.0981 |
| S\*6 = 0.1988  |  S‾6 = 0.0510 |
| S\*7 = 0.1299  | S‾7 = 0.1896 |

Table-12 values of separation from +ve benchmark nanomaterial to –ve benchmark nanomaterial

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Candidate Nanomaterials** | **TOPSIS-****Closeness****to the****+ve benchmark****nanomaterial Ci\*** | **Rank****based on Ci\*** | **COS based****on Line****Graph COSVL** | **Rank****Based on COSVL** |
| AgNW115 (N1) | 0.1953 | 7 | 0.3746 | 7 |
| NanoXactTM AU Nanoparticle (N2) | 0.3873 | 4 | 0.5101 | 5 |
| QGraphene® - 50 (N3) | 0.6931 | 1 | 0.7248 | 2 |
| QSI-Nano® Silver (N4) | 0.4267 | 3 | 0.6513 | 3 |
| AgNW60 (N5) | 0.3255 | 5 | 0.5173 | 4 |
| NanoPore™ HP-150 (N6) | 0.2041 | 6 | 0.4126 | 6 |
| Q Tubes® 250 (N7) | 0.5934 | 2 | 0.7729 | 1 |

Table-13 evaluation and ranking of the candidate nanomaterial

**Dipole moment**

**Stiffness**

**Band gap**

 Density Density Poisson’s ratio

 Electrical conductivity

Polarity Electrical permittivity Young’s modulus

 Band structure

 Dielectric constant % Elongation Luminescence

 Charge Mobile charge

 Quantum confinement

Polarization Chemical potential Photonic crystal

Potential energy

 Torque

**Nanomaterial Characterization**

 Quantum defect

 Toughness Morphology

Temp gradient Melting point Endurance limit

 Thermal shock

 resistance Graphitization Dislocation

Thermal Thermal conductivity Surface area Threshold Temperature

Expansion Surface energy

Quantum Tensile strength

 defect Strengthening

 Surface tension Fatigue strength

**Resistance**

**Nucleation**

**Fatigue**

Figure-1



Figure-2

Figure-3