**Table S2a:** Applications of NanoParticles (NPs) in various fields

|  |  |  |
| --- | --- | --- |
| Diagnostic tools  Drug delivery  Direct therapeutics  Multifunctional theranostics | *In vitro* and *in vivo* imaging and determination of tumor markers.  Direct and indirect coupling of drugs to single or core-shell inorganic NPs.  Chemotherapeutic agents  Diagnostics and targeted therapies administration | [112] |

**Table S2b:** Applications of NanoParticles (NPs) in various fields

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Drug Formulations** | **Chemicals/Polymers** | **Active ingredients** | **Cell line/Receptor** | **Outcome** | **References** |
| Polymeric NPs of Docetaxel | Pluronic F-127 | DTX | HER-2+ cell line | Increase uptake and cytotoxicity | [165] |
| Magnetically hybrid NPs | PEG-PAsp | siRNA | VEGF gene overexpressed  BC cell. | Higher amount of RNA found in BC cell | [166] |
| NPs | Iron oxide, EDTA–PBS+2 mercaptoethanolamine kit | anti-HER2 antibody  TZ on iron oxide | HER2+ BC  MDA-MB-468 | Improved binding (≥ 97%) HER2+ cells  Increased cytotoxicity of TZ NPs in HER2+ BC cells | [167] |
| SLNPs of tamoxifen | TMX | TMX | MCF7 and MCF7-TamR | Improved TAM efficacy and abolished Tam resistance by inducing death | [168] |
| H-Ferritin-nanocaged Olaparib | Cu(II) | H-Ferritin nano formulated  Olaparib (Poly(ADP-ribose) | BRCA-mutated and nonmutated  TNBC cells | Increased antitumor activity or Olaparib up to 1000X | [169] |
| Gold NPs | FA, Glucose, and glutamine as targeting  agent | Gold | Breast cancer cell | Improve tumor-specificity and radio sensitizing ability of BSA-GNPs | [170] |
| NanoMIL-100(Fe): DTX | FeCl3.6H2O | DTX | Human BC cell line, MCF-7 | Adverse effects of DTX reduced  IC50 value was observed 0.198 lµ/mL at first 24 hours | [171] |
| AuNPs | Lactose, phthalocyanine | Au | Galectin-1 receptor on the  the surface of BC cells | Lactose has been shown to be a particular targeting molecule for galactose-binding proteins | [172] |
| AS1411 aptamer | Aptamer-functionalized albumin, iron oxide, Au | Gold, DOX | MCF7 and SKBR3 human  CCs | Boosted cellular intake and activity | [173] |
| Gold NPs with cullin-5 DNA | Chloroauric acid, Au, L-glutathione | Cullin-5 DNA | 17-AAG in cullin-5 | AuNPs expressing Cul5 DNA make Cul5 deficient AU565 cells more sensitive to 17-AAG and boost their cytotoxic effects. | [174] |
| FA conjugated graphene oxide grafted MAN | FA, methyl acrylate | PTX | FR/human BC cell line (MDA-MB-231) | *In vitro*, the conjugation had a 39% anticancer potential, and *in vivo*, it significantly reduced breast tumors and mitochondrial citric acid enzymes to normal levels. | [175] |
| CNT-drug complex | hydrophilic polymer, PEG, and β‑estradiol (E2) | lobaplatin | ER in human  BC cells (HBCUs) | Demonstrating continuous release qualities, there are no clear harmful effects. | [176,177] |
| Polymer coated gold-ferric oxide  superparamagnetic NPs | Magnetic iron oxide NPs using poly-L-Lysine polymer | Au, ferric oxide for  theranostics | BT-474 and MDA-MB-231  BC cells | The cells inhibited BT-474 and MDA-MB-231 cell proliferation by 40 and 60% after a photothermal laser-activated internalized NPs. | [178] |
| Magnetic PMs | Magnetite (Fe3O4) core with copolymer of zein lactoferrin encapsulated with dasatinib | Dasatinib | TNBC cell  line (MDA-MB-231) | PMs inhibited cellular migration, and also inhibited the phosphorylated c-Src | [179] |
| Biodegradable PMs | Alendronate modified copolymer loaded with docetaxel (ALN-m/DTX) | Alendronate | 4T1 BC cell line | Suppressed disease progression, improved survival in a syngeneic murine model of BC bone metastasis | [180] |
| Carbosilane Ruthenium Dendrimers (CRD) | Graphene oxide modified gold nanowires (GO  AuNWs) | Carbosilane Ruthenium | MCF7 cells | Ultrasound-propelled AuNWs exhibited faster cell internalization, and accelerated the delivery of the CRD to the MCF7 cells | [181] |
| Polyamidoamine dendrimers (PAMAM) | PAMAM dendrimers loaded with methotrexate and D-glucose | PAMAM | MDA-MB-231 cell line | Reduced the cell viability up to 20% and glycosylation doubled the internalization of OS-PAMAM conjugates in cancer cells | [182] |