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Supporting information

Recent research on material-based methods for isolation of extracellular vesicles

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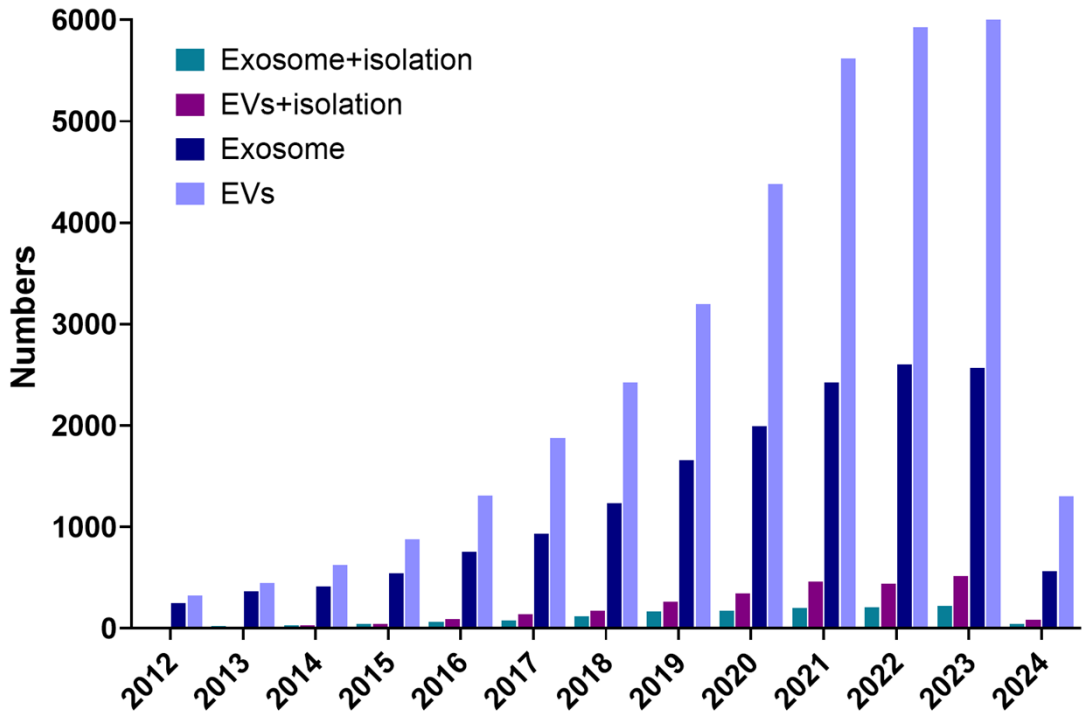

Figure S1. Literature survey of published articles using a search query with keywords "extracellular vesicles", "exosome", "extracellular vesicles and isolation" or "exosome and isolation".

Table S1. Comparison of isolation methods for EVs based on materials.

Material	Physical Properties	Functions	Isolation principle	Release principle	Advantages	Defects	Ref.
Magnetic beads	Nanometer or micro scale, magnetic	Antibodies	Specific binding of antibodies to membranes proteins of EVs	DNase，β-CD/α-CD-AAB and Tag II/Tactin-Strep	Magnetic separation, high specificity, high purity	High cost and low recovery rate	19, 25-31
		Aptamers	Specific binding of aptamers to membranes proteins of EVs	DNase and complementary			53, 55, 56
		Lipid probe	The tail end of lipid probe inserted into the phospholipid bilayer of EVs	DNase, dethiobiotin/biotin-avidin	Magnetic separation, simple, sensitive, efficient and time-saving	Low specifity	64, 69
Micro-fluidic chip	Polymer substrate, miniaturized and integrated	Antibodies, magnetic beads or polystyrene spheres containing antibodies	Specific binding of antibodies to membranes proteins of EVs	Cutble difulfide bonds, dethiobiotin/biotin-avidin and can also be directly detected by online analysis without release.	Microanalysis is suitable, time saving, high efficiency and high specificity	High equipment and low recovery rate	20, 35, 37, 38, 40-43, 46, 48
		Aptamers	Specific binding of aptamers to membranes proteins of EVs				58
		Lipid probe	The tail end of lipid probe inserted into the phospholipid bilayer of EVs				65

Material	Physical Properties	Functions	Isolation principle	Release principle	Advantages	Defects	Ref.
Paper	Lager number of cellulose sites	Antibodies	Specific binding of antibodies to membranes proteins of EVs	No release	Simple, controllable cost and high specificity	Low recovery and no active release	44, 45
Grapheres	High surface area and lager number of hydrophilic groups	Antibodies	Specific binding of antibodies to membranes proteins of EVs	No release	High specificity and on-line processing	Inactive release	46
		Ti^{4+}	Binding of positive metal ions to phosphate groups in negative vesicle phospholipid membranes		Simple, fast and high recovery rate	Low specificity	47
Methacrylate copolymer	Spherical porous structure	Antibodies	Specific binding of antibodies to membranes proteins of EVs	Alkaline elution	Simple, fast, cost controllable and high specificity	Low recovery	21, 48, 49
Conductive copolymer coated cloth	Electrochemical control	Antibodies	Specific binding of antibodies to membranes proteins of EVs	Electrochemical release	Simple, fast, cost controllable and high specificity	Low recovery and high equipment dependence	50
		Aptamers	Specific binding of aptamers to membranes proteins of EVs				54
Iron oxide nanowires	High specific surface area and strong magnetism	Antibodies	Specific binding of antibodies to membranes proteins of EVs	Acidic elution	Simple, fast, cost controllable and high specificity	Low recovery	32

Material	Physical Properties	Functions	Isolation principle	Release principle	Advantages	Defects	Ref.
Polyamide-amine dendritic polymer	Nanometer scale, high density of active sites	Antibodies	Specific binding of antibodies to membranes proteins of EVs	No release	High sensitivity and high specificity	High cost and no active release	22
Au nanoparticle	Nanometer scale and stable properties	Antibodies	Specific binding of antibodies to membranes proteins of EVs	No release	Easy to operate, time efficient and high specificity	High cost	24
Polystyrene microsphere	Micron size and adjustable diameter	Antibodies	Specific binding of antibodies to membranes proteins of EVs	No release	Simple, time-saving, cost controllable and high specificity	Low recovery	23
Zinc oxide nanowires	Nanometer scale and high specific surface area	Aptamers	Specific binding of aptamers to membranes proteins of EVs	NaCl solution	Cost controllable and high specificity	Low recovery	60
Silicon dioxide pellets	Micro scale, high specific surface area, dispersion and stability	Aptamers	Specific binding of aptamers to membranes proteins of EVs	Alkaline elution	Simple operation, high recovery rate and low cost	Low specificity	61
Morpho wings	3D micro-groove structure and high specific surface area	Lipid probe	The tail end of lipid probe inserted into the phospholipid bilayer of EVs	No release	High recovery	Low specificity	66

Material	Physical Properties	Functions	Isolation principle	Release principle	Advantages	Defects	Ref.
Metal-organic framework	Nanometer scale, high specific surface area and high porosity	Antibody	Specific binding of antibodies to membranes proteins of EVs	Neutral chelating agent	High specificity	High cost	80, 87
		Aptamers	Specific binding of aptamers to membranes proteins of EVs	DNase	High specificity	Low recovery	70
		Lipid probe	The tail end of lipid probe inserted into the phospholipid bilayer of EVs	No release	Simple operation, sensitive and fast	Low specificity	68
		Metal oxide	Affinity between metal oxide structure and EVs phospholipid membrane	Alkaline elution	Simple and easy, high recovery	Low specificity	68, 87
TiO_2 beads	Micron scale, spherical	Ti-O	Affinity between metal oxide structure and EVs phospholipid membrane	Alkaline elution	Simple and easy, high recovery	Low specificity	75, 76, 79, 81, 82, 114
		Antibody	Specific binding of antibodies to membranes proteins of EVs	No release	High specificity	High cost	87
		Aptamers	Specific binding of aptamers to membranes proteins of EVs	No release	High specificity	High cost	78, 83
CaZrO3 Nanosheets	Nanometer scale, high specific surface area and high chemical stability	Zr-O	Affinity between metal oxide structure and EVs phospholipid membrane	Alkaline elution	High recovery	Low specificity	88