

Supplementary Information

Manuscript: “Comparative hazard analysis and toxicological modeling of diverse nanomaterials using the embryonic zebrafish (EZ) metric of toxicity”.

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Online Resource 1: Detailed information on nanoparticles included in the study.

Publication / Figure Legend Title	Core Composition	Surface Chemistry	Manufacturer	Manufacturer #
Gold-MEE (2nm)	gold	2-(2-mercaptoethoxy)ethanol	Jim Hutchison; University of Oregon	N/A
Gold-TMAT (0.8nm)	gold	N,N,N-trimethylammoniummethanethiol	Jim Hutchison; University of Oregon	N/A
Gold-MES (0.8 nm)	gold	2-mercaptoethanesulfonate	Jim Hutchison; University of Oregon	N/A
Gold-MEE (0.8nm)	gold	2-(2-mercaptoethoxy)ethanol	Jim Hutchison; University of Oregon	N/A
Gold-TMAT (2nm)-ultrapure	gold	N,N,N-trimethylammoniummethanethiol	Jim Hutchison; University of Oregon	N/A
Gold-TMAT (2nm)-ultrapure	gold	N,N,N-trimethylammoniummethanethiol	Jim Hutchison; University of Oregon	N/A
Gold-TMAT (2nm)-pure	gold	N,N,N-trimethylammoniummethanethiol	Jim Hutchison; University of Oregon	N/A
Gold-TMAT (2nm)-as synthesized	gold	N,N,N-trimethylammoniummethanethiol	Jim Hutchison; University of Oregon	N/A
Gold-MES (2nm)-ultrapure	gold	2-mercaptoethanesulfonate	Jim Hutchison; University of Oregon	N/A
Gold-MES (2nm)-ultrapure	gold	2-mercaptoethanesulfonate	Jim Hutchison; University of Oregon	N/A
Gold-MES (2nm)-pure	gold	2-mercaptoethanesulfonate	Jim Hutchison; University of Oregon	N/A
Gold-TMAT (2nm)-as synthesized	gold	N,N,N-trimethylammoniummethanethiol	Jim Hutchison; University of Oregon	N/A
Gold-TMAT (10nm)	gold	N,N,N-trimethylammoniummethanethiol	Jim Hutchison; University of Oregon	N/A
Gold-MHA (10nm)	gold	6-mercaptohexanoic acid	Jim Hutchison; University of Oregon	N/A
Gold-MEEE (0.8nm)	gold	2,2,2-[mercaptoethoxy(ethoxy)]ethanol	Jim Hutchison; University of Oregon	N/A
Gold-MEEE (2nm)	gold	2,2,2-[mercaptoethoxy(ethoxy)]ethanol	Jim Hutchison; University of Oregon	N/A
Gold-MEEE (10nm)	gold	2,2,2-[mercaptoethoxy(ethoxy)]ethanol	Jim Hutchison; University of Oregon	N/A
Gold-MEPA (2nm)	gold	2-mercaptoethylphosphonic acid	Jim Hutchison; University of Oregon	N/A
G3 PAMAM dendrimer - amine	1,4-diaminobutane STARBURST® PAMAM	amine	Dendritic Nanotechnologies Inc.	DNT-104
G4 PAMAM dendrimer - amine	1,4-diaminobutane STARBURST®	amine	Dendritic Nanotechnologies Inc.	DNT-105

	PAMAM			
G5 PAMAM dendrimer - amine	1,4-diaminobutane STARBURST® PAMAM	amine	Dendritic Nanotechnologies Inc.	DNT-106
G6 PAMAM dendrimer - amine	1,4-diaminobutane STARBURST® PAMAM	amine	Dendritic Nanotechnologies Inc.	DNT-107
G6 PAMAM dendrimer - succinamic acid	1,4-diaminobutane STARBURST® PAMAM	succinamic acid	Dendritic Nanotechnologies Inc.	DNT-108
G6 PAMAM dendrimer - amidoethanol	1,4-diaminobutane STARBURST® PAMAM	amidoethanol	Dendritic Nanotechnologies Inc.	DNT-109
Aluminium Oxide (25nm)	aluminium oxide	aluminum oxide	Sigma-Aldrich	642991
Titanium Dioxide (30nm)	titanium(IV) oxide	titanium dioxide	Sigma-Aldrich	634662
Zirconium Oxide (50nm)	zirconium(IV) oxide	zirconium oxide	Sigma-Aldrich	544760
Cerium Oxide (13nm)	cerium(IV) oxide	cerium oxide	Sigma-Aldrich	544841
Gadolinium Oxide (25nm)	gadolinium(III) oxide	gadolinium oxide	Sigma-Aldrich	637335
Dysprosium Oxide (25nm)	dysprosium(III) oxide	dysprosium oxide	Sigma-Aldrich	639664
Yttrium Oxide (25nm)	yttrium(III) oxide	yttrium oxide	Sigma-Aldrich	641901
Holmium Oxide (25nm)	holmium(III) oxide	holmium oxide	Sigma-Aldrich	641863
Samarium Oxide (25nm)	samarium(III) oxide	samarium oxide	Sigma-Aldrich	637319
Silicon Dioxide / Alumina (25nm)	alumina-doped silicon dioxide	alumina doped silicon dioxide	Sigma-Aldrich	701491
Erbium Oxide (25nm)	erbium(III) oxide	erbium oxide	Sigma-Aldrich	637343
Polystyrene FluoSphere (20nm) - carboxylated	polystyrene	carboxyl	Invitrogen/Molecular Probes	F8787
Polystyrene FluoSphere (20nm) - sulfonated	polystyrene	sulfate	Invitrogen/Molecular Probes	F8845
Polystyrene FluoSphere (20nm) - aldehyde-sulfate	polystyrene	aldehyde-sulfate	Invitrogen/Molecular Probes	F8760
Gold - phosphatidylcholine (7nm)	gold	phosphatidylcholine	Scott Reed; Portland State University	N/A
Gold - phosphatidylcholine (7nm)	gold	phosphatidylcholine	Scott Reed; Portland State University	N/A

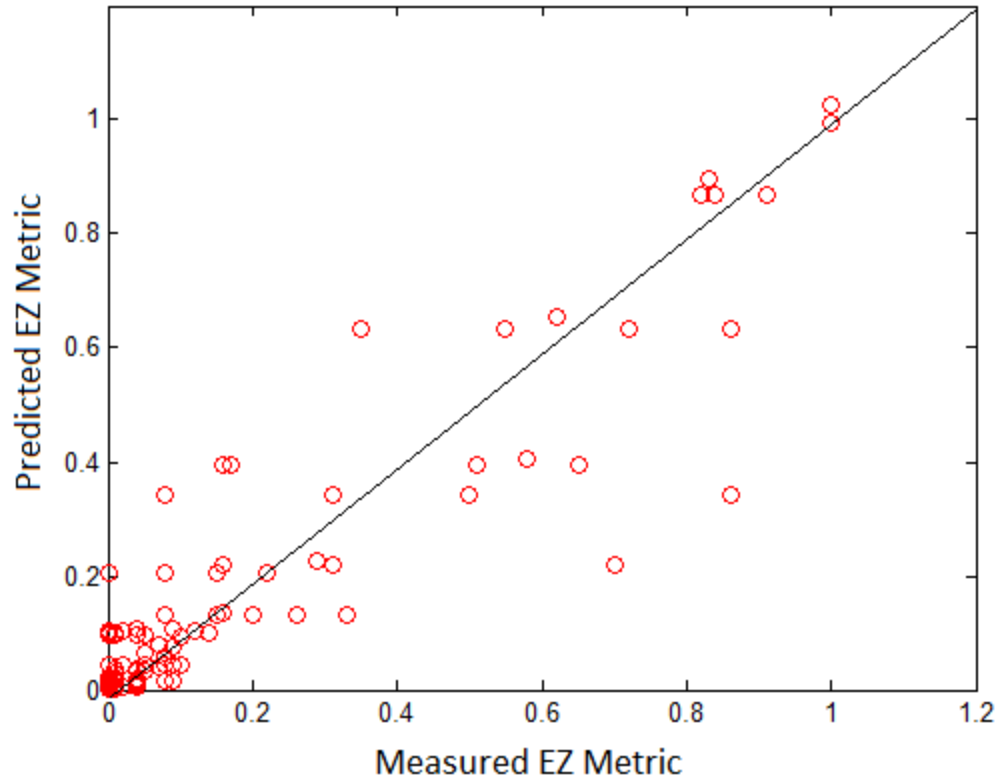
Gold - phosphatidylcholine (22nm)	gold	phosphatidylcholine	Scott Reed; Portland State University	N/A
Gold - phosphatidylcholine (14nm)	gold	phosphatidylcholine	Scott Reed; Portland State University	N/A
Gold - phosphatidylcholine (14nm)	gold	phosphatidylcholine	Scott Reed; Portland State University	N/A
Nanocrystalline Cellulose - carboxylated	cellulose	carboxyl	John Simonsen; Oregon State University	N/A
Nanocrystalline Cellulose - sulfonated	cellulose	sulfate	John Simonsen; Oregon State University	N/A
Zinc Oxide - oleic acid (62nm)	zinc oxide	oleic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide - oleic acid (26nm)	zinc oxide	oleic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide (62nm)	zinc oxide	zinc oxide	Sigma-Aldrich	544906
Zinc Oxide (26nm)	zinc oxide	zinc oxide	Andreas Stonas; Voxtel	N/A
Zinc Oxide - octanoic acid acid (62nm)	zinc oxide	octanoic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide - octanoic acid acid (26nm)	zinc oxide	octanoic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide - para-nitrobenzoic acid (62nm)	zinc oxide	para-nitrobenzoic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide - para-nitrobenzoic acid (26nm)	zinc oxide	para-nitrobenzoic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide - cyclohexane carboxylic acid (62nm)	zinc oxide	cyclohexane carboxylic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide - cyclohexane carboxylic acid (26nm)	zinc oxide	cyclohexane carboxylic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide - benzoic acid (62nm)	zinc oxide	benzoic acid	Andreas Stonas; Voxtel	N/A
Zinc Oxide - benzoic acid (26nm)	zinc oxide	benzoic acid	Andreas Stonas; Voxtel	N/A
Silicon Dioxide - FITC (54nm)	silica dioxide	fluorescein isothiocyanate	Alex Punnoose; Boise State University	N/A
Silver - citrate (10nm)	silver	citrate	Nanocomposix Inc.	CTH1148
Silver/Gold - phosphate (21nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1085
Silver/Gold - phosphate (33nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1088
Silver/Gold - phosphate (41nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1083
Silver/Gold - phosphate (53nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1092
Silver/Gold - phosphate (61nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1082
Silver/Gold -	silver coated	phosphate	Nanocomposix Inc.	CTH1108

phosphate (68nm)	gold			
Silver/Gold - phosphate (70nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1039
Silver/Gold - phosphate (92nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1112
Silver/Gold - phosphate (101nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1084
Silver/Gold - phosphate (122nm)	silver coated gold	phosphate	Nanocomposix Inc.	CTH1066
Zinc Oxide (5nm)	zinc oxide	zinc oxide	Alex Punnoose; Boise State University	N/A
Iron Oxide (110nm)	iron oxide	iron oxide	Alex Punnoose; Boise State University	N/A
Zinc Oxide (4nm)	zinc oxide	zinc oxide	Alex Punnoose; Boise State University	N/A
Lead Sulfide - monothiol, unoxidized (3nm)	lead sulfide	3-mercaptopropanesulfonic acid, sodium salt	Ian Moody; University of Oregon	N/A
Lead Sulfide - monothiol, oxidized (3nm)	lead sulfide	3-mercaptopropanesulfonic acid, sodium salt	Ian Moody; University of Oregon	N/A
Lead Sulfide - dithiol, unoxidized (3nm)	lead sulfide	2,3-dimercaptopropanesulfonic acid, sodium salt	Ian Moody; University of Oregon	N/A
Lead Sulfide - dithiol, oxidized (3nm)	lead sulfide	2,3-dimercaptopropanesulfonic acid, sodium salt	Ian Moody; University of Oregon	N/A
Zinc Oxide (15nm)	zinc oxide	zinc oxide	Alex Punnoose; Boise State University	N/A
Zinc Oxide (34nm)	zinc oxide	zinc oxide	Alex Punnoose; Boise State University	N/A
Zinc Oxide (5nm)	zinc oxide	zinc oxide	Alex Punnoose; Boise State University	N/A
Zinc Oxide (10nm)	zinc oxide	zinc oxide	Alex Punnoose; Boise State University	N/A
Zinc Oxide (5nm)	zinc oxide	zinc oxide	Alex Punnoose; Boise State University	N/A

Online Resource 2: Estimated nanomaterial concentrations eliciting 0.1 weighted EZ Metric score used to determine hazard ranking of lower toxicity materials.

Material	EZM EC₁₀
Silicon Dioxide - FITC (54nm)	0.001
Zinc Oxide - benzoic acid (62nm)	0.001
Nanocrystalline Cellulose - sulfonated	0.001
Zinc Oxide (10nm)	0.002
Iron Oxide (110nm)	0.002
Zinc Oxide (34nm)	0.002
Zinc Oxide - benzoic acid (62nm)	0.002
Zinc Oxide - oleic acid (26nm)	0.003
Nanocrystalline Cellulose - carboxylated	0.003
Lead Sulfide - dithiol, unoxidized (3nm)	0.003

Zinc Oxide (5nm)	0.004
Zinc Oxide (62nm)	0.004
Zinc Oxide - octanoic acid acid (26nm)	0.004
Zinc Oxide (26nm)	0.004
Zinc Oxide - octanoic acid acid (62nm)	0.004
Zinc Oxide (5nm)	0.005
Cerium Oxide (13nm)	0.006
Zinc Oxide (5nm)	0.011
Zinc Oxide - cyclohexane carboxylic acid (62nm)	0.015
Zinc Oxide (15nm)	0.022
Yttrium Oxide (25nm)	0.050
Zinc Oxide - oleic acid (62nm)	0.591
Zinc Oxide - para-nitrobenzoic acid (62nm)	0.601
Polystyrene Fluorosphere (20nm) - sulfonated	0.849
Polystyrene Fluorosphere (20nm) - aldehyde-sulfate	0.864
G6 PAMAM dendrimer - amidoethanol	2.071
Gold-MES (2nm)-ultrapure	2.406
Zirconium Oxide (50nm)	7.244
Silicon Dioxide / Alumina (25nm)	7.674
Gold-TMAT (10nm)	10.904
Lead Sulfide - dithiol, oxidized (3nm)	19.555
Gold-MES (2nm)-ultrapure	20.249
Titanium Dioxide (30nm)	25.119
Gold-MEPA (2nm)	50.000
Gold-MES (2nm)-pure	55.208
Polystyrene Fluorosphere (20nm) - carboxylated	58.715
Zinc Oxide (4nm)	60.954
Gold-MES (0.8 nm)	92.045
Zinc Oxide - cyclohexane carboxylic acid (26nm)	176.807
G6 PAMAM dendrimer - succinamic acid	201.837



Online Resource 3: Plot of predicted EZ Metric values obtained with the model in Equation 3 (y-axis) against measured EZ Metric values (x-axis). The black line represents perfect prediction. R-squared value is 0.8811, the adjusted R-squared is 0.8719.