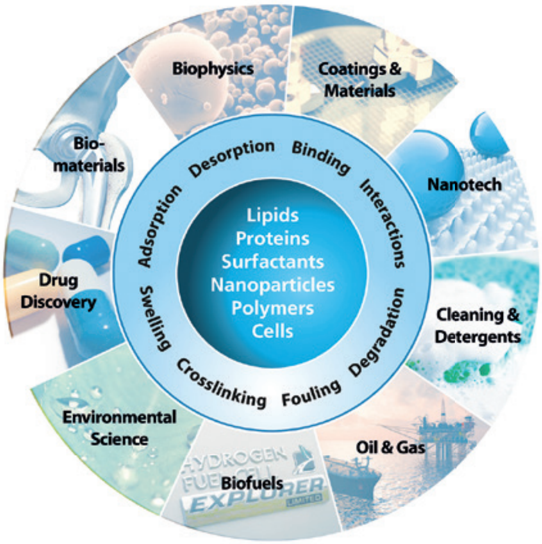
Quality sensors

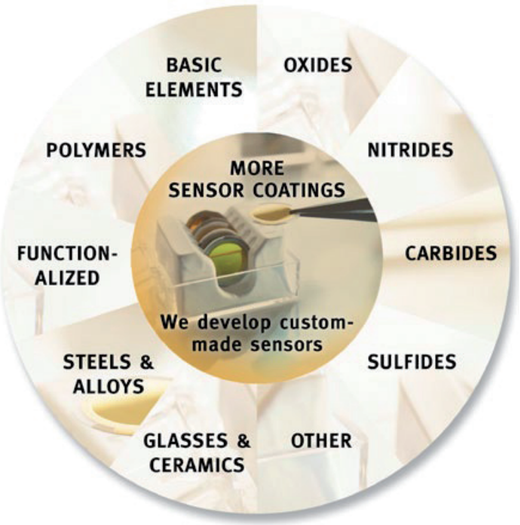


Q-Sense takes pride in the extensive range of high quality sensors developed and produced in our world class in-house facilities. When you buy Q-Sensors they are quality tested to ensure reliability and quality guaranteed for QCM-D studies.
All this so you can get the most out of your time spent planning and executing experiments.

Our wide range – your possibilities

Q-Sense standard collection of Q-Sensors contains a wide range of materials such as basic elements, polymers, steels and functional surfaces and much more to accommodate the many different customer needs. Customers are found in research ranging from molecular and medical sciences, to environmental sciences, oil and gas and detergent and cleaning research.

Explore the list of coating materials to discover your research possibilities.



Sensor specifications	
Frequency	4.95 MHz ±50 kHz
Cut	AT
Electrode layer	40 nm – 1 µm
Size	Diameter: 14 mm, Thickness: 0.3 mm
Finish	Optically polished, surface roughness of electrode less than 3 nm (RMS)

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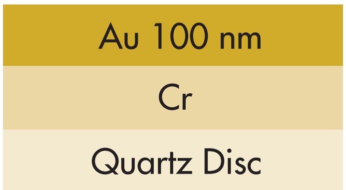
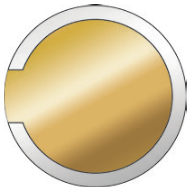
Quality sensors
QSX 301 Gold & QSX 303 SiO_2

Layer structure

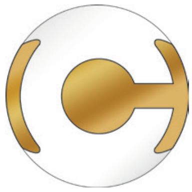


Not to scale

Sensor Layout

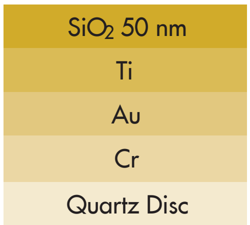


Top side



Back side

Layer structure



Not to scale

Sensor specification		
Description	QSX 301 Gold	QSX 303 SiO_2
Quartz disc	AT - cut, fundamental frequency 5 MHz	AT - cut, fundamental frequency 5 MHz
Top coating material	Gold (Au) (The chemical composition was confirmed by XPS.)	Silicon Dioxide (SiO_2) (The chemical composition was confirmed by XPS.)
Thickness	100 nm	50 nm
Surface roughness	Rms: 0.9 nm ±0.2 nm (Ref. AFM.)	Rms: 1.2 nm ±0.1 nm (Ref. AFM.)
Coating method	PVD (Physical Vapor Deposition)	PVD (Physical Vapor Deposition)
Operating temperature range	4 – 260 °C (Inert atmosphere. Temperatures over 260 °C are not tested. Above 573 °C, the quartz material undergoes a phase change and looses the piezoelectric property)	5 – 250 °C (Inert atmosphere. Temperatures over 250 °C are not tested. Above 573 °C, the quartz material undergoes a phase change and looses the piezoelectric property)
Cleaning method (The suggested method is not harmful to the sensor coatings themselves, however note that there is no guarantee that materials adsorbed onto the coatings are removed - this depends on the coupling chemistry of the adsorbed materials.)	1. UV/ozone treat for 10 minutes	1. UV/ozone treat for 10 minutes (see UVO treatment)
	2. Heat a 5:1:1 mixture of milliQ water, ammonia (25 %) and hydrogen peroxide (30%) to 75 °C, approx. 10 ml is sufficient	2. Prepare a solution of 2% Sodium Dodecyl Sulfate in milliQ water
	3. Place the sensor in the heated solution for 5 minutes	3. Immerse the sensor surfaces in the solution for 30 minutes in room temperature
	4. Rinse with milliQ water. It is important that the surfaces are kept wet after ammonium-peroxide immersion until they are rinsed well with water	4. Rinse with milliQ water. It is important that the surfaces are kept wet after ammonium-peroxide immersion until they are rinsed well with water
	5. Dry with nitrogen gas	5. Dry with nitrogen gas
	6. UV/ozone treat for 10 minutes	6. UV/ozone treat for 10 minutes

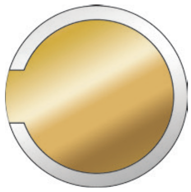
Quality sensors
QSX 304 SS2343 & QSX 305 PS

Layer structure

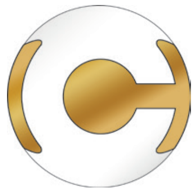
SS2343 100 nm
Ti
Au
Cr
Quartz Disc

Not to scale

Sensor Layout



Top side



Back side

Layer structure

PS 50 nm
Au
Cr
Quartz Disc

Not to scale

Sensor specification		
Description	QSX 304 SS2343	QSX 305 PS
Quartz disc	AT - cut, fundamental frequency 5 MHz	AT - cut, fundamental frequency 5 MHz
Top coating material	Stainless Steel (SS2343) (The chemical composition was confirmed by XPS.)	Polysterene (PS) (The chemical composition was confirmed by TOF - SIMS..)
Thickness	100 nm	50 nm
Surface roughness	RMS: 1.4 nm ±0.2 nm (Ref. AFM.)	Rms: 0.3 nm ±0.1 nm (Ref. AFM.)
Coating method	PVD (Physical Vapor Deposition)	Spin coating
Operating temperature range	4 – 60 °C (Inert atmosphere. Temperatures over 60 °C are not tested. Above 573 °C, the quartz material undergoes a phase change and looses the piezoelectric property.)	4 – 90 °C (Inert atmosphere. Temperatures over 90 °C are not tested. Above 573 °C, the quartz material undergoes a phase change and looses the piezoelectric property.)
Cleaning method (The suggested method is not harmful to the sensor coatings themselves, however note that there is no guarantee that materials adsorbed onto the coatings are removed - this depends on the coupling chemistry of the adsorbed materials.)	1. Immerse the sensor surfaces in 1 % Hellmanex II (www.hellma.com) for 30 minutes at room temperature. QSX 304 can be kept in the solution for 12 hours	1. Prepare a solution of 1 % Deconex 11 (see www.borer.ch) in milliQ water
	2. Rinse with milliQ water	2. Immerse the sensor surfaces in the solution for 30 min at 30 °C temperature
	3. Dry with nitrogen gas	3. Rinse with milliQ water
	4. Sonicate in 99% ethanol for 10 minutes	4. Keep in milliQ water for at least 2 hours
	5. Rinse with milliQ water	5. Rinse with 99% ethanol
	6. Dry with nitrogen gas	6. Dry with nitrogen gas
	7. UV/ozone treat for 10 minutes	
Chemical compability	No strong acids	No organic solvents

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Quality sensors
QSX 309 Al_2O_3

The QSensors are developed and produced to provide you with stable, reliable and reproducible data. Full performance is ensured through extensive quality controls and guaranteed for one-time use according to the recommendations.

Sensor specifications	
Description	QSX 309 Al_2O_3 (Aluminium oxide)
Top coating material	Aluminium oxide (Al_2O)[A]
Surface roughness	< 2 nm RMS[B]
Maximum temperature[C]	150 °C
Pre-cleaning of sensor	A new sensor might be contaminated with hydrocarbons and dust. Pre-cleaning the surface will give more reproducible QCM-D results.
Protocol light	For light cleaning, step 2 - 4 below can be used.
Protocol thorough[D, E, F]	1. Sonicate the sensor surfaces in 99% ethanol for 15 minutes.
	2. Rinse with milliQ water.
	3. Dry with nitrogen gas.
	4. UV/ozone treat for 10 minutes (see UVO treatment).
Usage	QSensors are intended for one-time use only.
Shelf life	Stable at least 12 months from package date in unopened package, see expiry date on package.
Storage	Store in a cool, dry place out of light.
Chemical compatibility	Do not expose to strong acids and bases. Stay within pH 4-9 to avoid corrosion.[G] There is no guarantee that the coating will be stable under all experimental conditions.
Specifications may be subject to change without notice.	
A - The chemical composition was confirmed by XPS.	
B - Ref. AFM.	
C - Sensor oscillates/works at 150 °C in air. Temperatures above 150 °C have not been tested. Note that ambient environment may influence coating behavior. Theoretically, the quartz and the Au coating withstand temperatures up to 573 °C where the quartz undergoes a phase transition altering its piezoelectric properties. The adhesion layers, the electrode and coating materials will migrate with time, and the migration rate is affected by temperature and time.	
D - The suggested pre-cleaning protocols for the sensors are not harmful to the sensor coatings themselves. If the protocols are used for cleaning the sensor after a measurement, note that there is no guarantee that materials adsorbed onto the coatings are removed.	
E - K. D. Kwon et al, Environ. Sci. Technol. 40 (2006) p27739	
F - Please see QSense "Instrument care and sensor pre-cleaning" for more info.	
G - http://www.aluminiumdesign.net	

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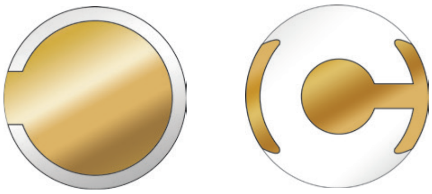
Quality sensors
QSX 310 Ti

Layer structure

Not to scale

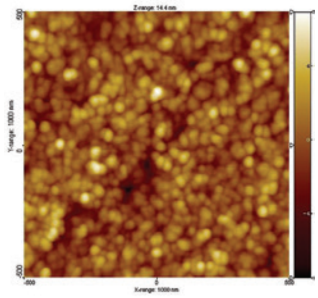
Sensor Layout



Top side

Back side

AFM picture



Sensor specification	
Description	QSX 310 Ti
Quartz disc	AT - cut, fundamental frequency 5 MHz
Top coating material	Titanium (Ti) (The chemical composition was confirmed by XPS.)
Thickness	120 nm
Surface roughness	Rms: 1.7 nm ±0.2 nm (Ref. AFM.)
Coating method	(PVD) Physical Vapor Deposition
Operating temperature range	4 – 250 °C (Inert atmosphere. Temperatures over 250 °C are not tested. Above 573 °C, the quartz material undergoes a phase change and looses the piezoelectric property.)
Cleaning method The suggested method is not harmful to the sensor coatings themselves, however note that there is no guarantee that materials adsorbed onto the coatings are removed - this depends on the coupling chemistry of the adsorbed materials.	1. Immerse the sensor surfaces in 1 % Hellmanex II (www.hellma.com) for 30 minutes at room temperature
	2. Rinse with milliQ water
	3. Dry with nitrogen gas
	4. Sonicate in 99 % ethanol for 10 minutes
	5. Rinse with milliQ water
	6. Dry with nitrogen gas
	7. UV/ozone treat for 10 minutes
Chemical compability	No strong acids or bases

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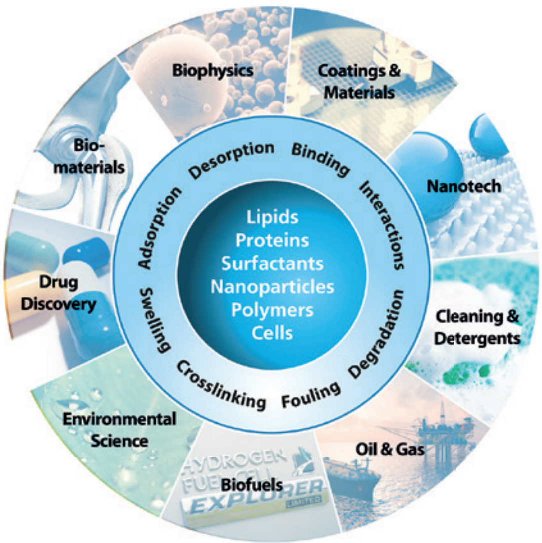
Quality sensors
QSX 313 Copper

The QSense sensors are developed and produced to provide you with stable, reliable and reproducible data. Full performance is ensured through extensive quality controls and guaranteed for one-time use according to the recommendations.

Sensor specifications	
Description	QSX 313 Copper sensor
Top coating material	Copper (Cu)[A]
Surface roughness	< 4 nm RMS[B]
Maximum temperature[C]	150 °C
Shelf life	Stable at least 12 months from package date in unopened package, see expiry date on package.
Storage	The sensor is delivered in inert atmosphere. Store in a cool, dry place out of light.
Chemical compatibility	Note that copper oxidizes easily and therefore is unstable in both air and water. There is no guarantee that the coating will be stable under all experimental condi tions.
Specifications may be subject to change without notice.	
A - The chemical composition was confirmed by XPS.	
B - Ref. AFM.	
C - Sensor oscillates/works at 150 °C in air. Temperatures above 150 °C have not been tested. Note that ambient environment may influence coating behavior. Theoretically, the quartz and the Au coating withstand temperatures up to 573 °C where the quartz undergoes a phase transition altering its piezoelectric properties. The adhesion layers, the electrode and coating materials will migrate with time, and the migration rate is affected by temperature and time.	



Quality sensors
QSX 336 Borosilicate glass & QSX 337 Soda-lime glass

Borosilicate glass is a type of glass with silica and boron trioxide as the main glass-forming constituents. Borosilicate glass has high resistance against thermal stress and is commonly used for the construction of e.g. cookware as well as laboratory and lighting glassware.

The QSense sensors are developed and produced to provide you with stable, reliable and reproducible data. Full performance is ensured through extensive quality controls and guaranteed for one-time use according to the recommendations.

Soda-lime glass, is the most common type of glass, e.g. used for bottles and jars for food and beverages as well as for windowpanes and glass containers.

The QSense sensors are developed and produced to provide you with stable, reliable and reproducible data. Full performance is ensured through extensive quality controls and guaranteed for one-time use according to the recommendations.

Sensor specifications		
Description	QSX 336 Borosilicate glass sensor	QSX 337 Soda-lime-glass sensor
Top coating material	Borosilicate	Soda-lime glass[A]
Surface roughness	< 2 nm RMS[B]	< 2 nm RMS[B]
Maximum temperature[C]	150 °C	150 °C
Pre-cleaning of sensor	A new sensor might be contaminated with hydrocarbons and dust. Pre-cleaning the surface will give more reproducible QCM-D results.	A new sensor might be contaminated with hydrocarbons and dust. Pre-cleaning the surface will give more reproducible QCM-D results.
Protocol light	For light cleaning, step 1, 4 and 5 below can be used.	For light cleaning, step 1, 4 and 5 below can be used.
Protocol thorough[D, E, F]	1. UV/ozone treat for 10 minutes	1. UV/ozone treat for 10 minutes
	2. Prepare a solution of 2 % Sodium Dodecyl Sulfate in milliQ water	2. Prepare a solution of 2 % Sodium Dodecyl Sulfate in milliQ water
	3. Immerse the sensor surfaces in the solution for 30 minutes in room temperature	3. Immerse the sensor surfaces in the solution for 30 minutes in room temperature
	4. Rinse with milliQ water. It is important that the surfaces are kept wet after SDS immersion until they are rinsed well with water	4. Rinse with milliQ water. It is important that the surfaces are kept wet after SDS immersion until they are rinsed well with water
	5. Dry with nitrogen gas	5. Dry with nitrogen gas
	6. UV/ozone treat for 10 minutes	6. UV/ozone treat for 10 minutes
Usage	QSensors are intended for one-time use only.	Soda-lime glass sensors are suitable for the evaluation of detergent etch properties. QSense sensors are intended for one-time use only.
Shelf life	Stable at least 18 months from package date.	Stable at least 18 months from package date.
Storage	Store in a cool, dry place out of light.	Store in a cool, dry place out of light.
Chemical compatibility	There is no guarantee that the coating will be stable under all experimental conditions.	There is no guarantee that the coating will be stable under all experimental conditions.
Specifications may be subject to change without notice.		
A - The chemical composition was confirmed by XPS.		
B - Ref. AFM.		
C - Sensor oscillates/works at 150 °C in air. Temperatures above 150 °C have not been tested. Note that ambient environment may influence coating behavior. Theoretically, the quartz and the electrode withstand temperatures up to 573 °C where the quartz undergoes a phase transition altering its piezoelectric properties. The adhesion layers, the electrode and coating materials will migrate with time, and the migration rate is affected by temperature and time.		
D - The suggested pre-cleaning protocols for the sensors are not harmful to the sensor coatings themselves. If the protocols are used for cleaning the sensor after a measurement, note that there is no guarantee that materials adsorbed onto the coatings are removed.		
E - K. Harewood et al, Anal. Biochem. 55 (1973) p573 and J. Penfold et al, Langmuir 18 (2002) p5755.		
F - Please see QSense "Instrument care and sensor pre-cleaning" for more info.		

Quality sensors
QSX 339 Biotin coupling

To prove that the Q-Sense Biotin functionalized sensor was still active after 8 weeks of storage, immobilization of Streptavidin and the subsequent binding of biotinylated Bovine Serum Albumin (biotin-BSA) were performed. The level of binding of these proteins, which corresponds to the level of binding activity of QSX 339, was measured with QCM-D. The values shown in Table 1 are dissipation and frequency shifts obtained at these immobilizations. These sensors were stored dark and at low temperatures (fridge) and retained up to 90% of the binding activity after 4 and 8 weeks.

Also, the associated dissipation shifts have the same characteristics as at starting point.

References

1. Edvardsson, M., et al., QCM-D and Reflectometry Instrument: Applications to Supported Lipid Structures and Their Biomolecular Interactions. Analytical Chemistry, 2009. 81(1): p. 349-361.
2. Glasmastar, K., et al., Protein adsorption on supported phospholipid bilayers. Journal of Colloid and Interface Science, 2002. 246(1): p. 40-47.
3. Hook, F., et al., Characterization of PNA and DNA immobilization and subsequent hybridization with DNA using acoustic-shear-wave attenuation measurements. Langmuir, 2001. 17(26): p. 8305-8312.
4. Larsson, C., M. Rodahl, and F. Hook, Characterization of DNA immobilization and subsequent hybridization on a 2D arrangement of streptavidin on a biotin-modified lipid bilayer supported on SiO_2. Analytical Chemistry, 2003. 75(19): p. 5080-5087.

Effectivness of Biotin activity after storage

	0 w	4 w	8 w
Streptavidin, f	-22.6 ±0.28	-20.55 ±0.21	-20.85 ±0.21
Streptavidin, D	-0.12 ±0.06	-0.08 ±0.03	0.09 ±0.07
Biotin-BSA, f	-17.1 ±0.14	-16.1 ±0.42	-17.0 ±0.35
Biotin-BSA, D	0.66 ±0.03	0.64 ±0.03	0.69 ±0.03

Frequency (f) and dissipation (D) shifts obtained at binding of Streptavidin and subsequently biotin-BSA as a measure of the Biotin activity. QSX 339 proves to be stable for 8 weeks of storage in dark and at low temperatures(fridge).

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Quality sensors
QSX 341 Amine coupling

Immobilizing biomolecules in a functional manner on a sensor surface is a successful way of analyzing biomolecular interactions.

Q-Sense Amine Coupling Sensor, QSX 341, enables covalent immobilization of biomolecules via their amino groups (-NH2) to a PEG coating activated with N-hydroxysuccinimide (NHS) (Figure 1). This allows for fast immobilization reactions with the non-reacted NHS groups easily washed off to expose the zero-background PEG coating.

- Delivered with NHS molecules bound
- Fast and easy immobilization reactions
- Any molecule of interest with free amine group
- Usage include antibody optimization (Figure 2), protein-protein interactions and probing of conformational changes

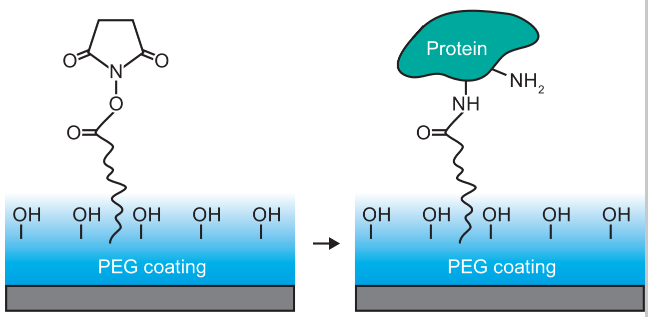

Figure 1. Pre-bound NHS-molecules on QSX 341 replaced via a covalent linkage to the amine groups on the surface of the protein.

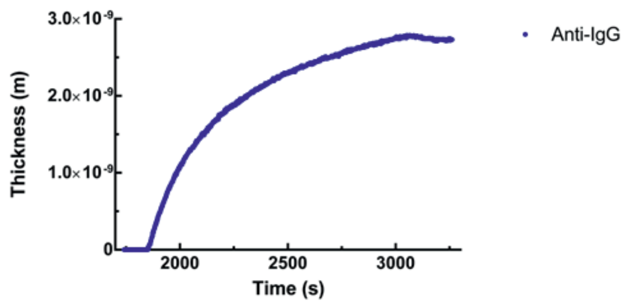

Figure 2. Thickness changes upon interaction of 70 nM Anti bovine-IgG with immobilized bovine IgG on QSX 341.

Sensor specification	
Description	QSX 341 Amine coupling sensor
Surface chemistry	Poly (ethylene glycol) (PEG) 3 nm coating and functionalization with a density of 10^{14} NHS molecules/cm^2.
Sensor base	SiO_2
Binding	The free NHS molecules on the sensor are replaced with a covalent linkage to the protein via its free amine groups.
Specificity	The zero-background PEG coating eliminates non-specific binding.
Usage	Direct mounting into the instrument from the box without prior cleaning (possibly blow with N2 gas for dust removal). The sensors come with the appropriate blocking buffer to remove non-reacted NHS molecules.
Storage	Stable >8 weeks from package date when stored in original vacuum-bag at -20 to -80 °C. Opened sensors should be stored in vacuum desiccator or in 100% nitrogen environment.

Quality sensors

Please see our standard collection of Q-Sensors below (for custom made sensors, please visit www.biolinscientific.com/ q-sense). For inspiration, we have added some examples of customer usage – but it is only your imagination that sets the limit!

Sensor description	Example of model systems	Example of application
Aluminium	Electrodes	Electrochemistry, lithium insertion, energy
Aluminium oxide	Water treatment plant, nanoparticles	Environmental
AlSO	Kaolinite mimic	Energy, mining
Amorphous Fluoropolymer AF1600 (from DuPont)	Teflon, non-stick surfaces, inert surfaces	Protein surfaces, cleaning and detergent analysis, petroleum
Barium Titanate	Dielectric ceramic used for capacitors	
Biotin (on gold)	Biological, biochemical interaction	Protein interactions, molecular biology, antigens
Borosilicate	Glass labware, syringes, cookware	Pharmaceuticals, cleaning and detergent anlysis
Calsium carbonate	Minerals (e.g. limestone, chalk, marble, tufa)	Energy, mining
Cellulose (on SiO_2)	Fabric, filter, fiber	Enzyme interactions, cleaning, electrochemistry, biofuels
Chromium	Coating	Corrosion, electronics
Cobalt	Orthopedic implant, battery, pigment	Medical device, energy, electroplating
Copper	Wire, cables, coating	Corrosion, antifouling
Gold	Universal surface	Thiols, anything – everything sticks to gold
Gold (Ti adhesion)	Universal surface	Fundamental electrochemistry
His-tag capturing	Biological systems, biochemical interactions	Antibody, protein-protein, probing of conformational changes
Hydroxyapatite	Bone, teeth, bioinspired material, mineral	Biomaterials, medical device
Iron	Combustion engine, nano particles	Corrosion, environmental transport, energy
Iron Oxide (Fe_2O_3 and Fe_3O_4)	Hematite and magnetite mimic, pipelines, nanoparticles, minerals	Solar energy, photo and pigment catalyst, corrosion, biofilm formation, environmental transport, energy
Magnesium	Mineral	Energy, mining, used in bikes, cars, cellphones
Molybdenum	Mineral	Energy, mining, aslo replaces Tungsten in some ferlalizer
NHS-Amine Coupling	Biological, biochemical interaction	Protein interactions, molecular biology, antigen antibody
Nylon "6.6"	Nylon fabric	Cleaning and detergent analysis
PEI	Additive, flocculating agent	Adhesives, water treatment, cosmetics, wet-strength agent
Platinum	Electrodes	Fuel cells, catalytic converters, energy
Polystyrene	Hydrophobic surface, filters	Cell studies, inert surfaces, filter interaction, medical device
PMMA	Plexiglas, bone cement, dental filling	Biomedical, lenses, aquariums, car headlights
PVDF	Plastic, pharmaceutical filter, falcon tubes	Container interactions, pharmaceutical industry
Silicon	Semiconductor	Energy, etching
Silicon carbide	Rare mineral moissanite, carbone supporters	Energy, catalyst, electronics
Silicon dioxide	Glass	Etching processes, silanization, cleaning and detergent analysis
Silicon nitride	Biomaterials, integrated circuits	Electronics, medical device
Silicon oxycarbide	Carbon supports, electrodes	Catalysts, LEDs, brakes, graphene production, energy
Silver	Nano particles, antimicrobial coating	Environmental transport, coatings, materials
Soda-lime glass	Household glass, labware	Cleaning products, surface interactions
Steel (SS2343, US 316 & L605)	Stents, acid resistant steel, stainless	Environmetal, medical device, blood coagulations
Tantalum	Electrodes, reactors	Alloys, electronics, energy
Tantalum Nitride	Electrodes	Electronics
Titanium	Medical implants	Medical Device, biomaterials
Tungsten	Electrodes	Etching processes
Zinc Oxide	Minerals	Mining, energy, rubber manufacuting, ceramic, calamine lotion
Zinc Sulfide	Minerals	Energy, mining, luminiscent and optical material, pigment
Zirconium oxide	Ceramic, fuel cell, membrane	Alloys Sintering, energy
* Please note that specifications in this brochure may be subject to change without notice		

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