STREM

Supported Nanoparticles From Laser Ablation in Liquids

Particular customized material

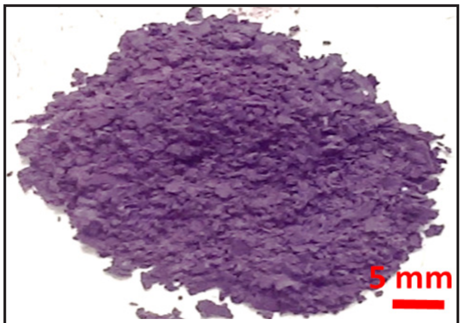
METALS • INORGANICS • ORGANOMETALLICS • CATALYSTS • LIGANDS • NANOMATERIALS • CUSTOM SYNTHESIS • cGMP FACILITIES

What is Laser Ablation in Liquids?

Laser ablation is a physical process used to generate nanoparticle catalysts. It involves the use of short pulses of laser energy focused on a target in a solvent. The target absorbs the energy of the laser pulse and is vaporized (see product line "Reactant & Surfactant-free pure Nanoparticles via Laser Ablation"). The vaporized material then condenses as nanoparticles, ready to be supported (Real-Time video, see: YouTube or click on the picture on the upper right side).

Adsorption of nanoparticles on catalyst supports: Simply by mixing, 100% yield

Nano-active powder for catalysis and more?

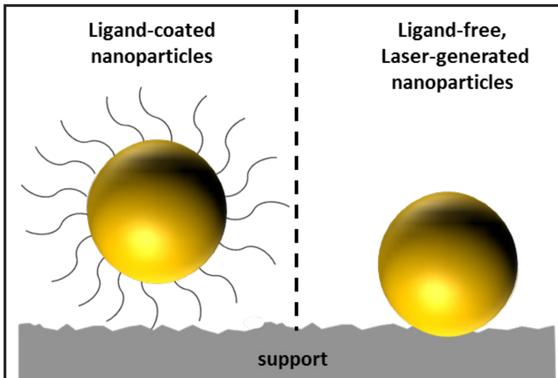


10 wt% gold nanoparticles on TiO2 as supporting material

Supported Laser-generated nanoparticles are powders with a high nano-activity. They are delivered as dry powders that can be stored for years without loss of quality. Laser fabrication leads to unusually high nanoparticle loads of up to 50 wt%, providing a high product functionality. Laser-generated nanoparticles for example consisting of gold, platinum, palladium, copper, or silver can be combined with a wide range of particulate supports like TiO_2, $BaSO_4$ or carbon black providing a wide spectrum of different material combinations for different fields of applications like catalysis, pigmentation, or as nanofunctional polymer additives.

Adsorption efficiency is generally very sensitive to ligand concentration. In chemical synthesis residual ligands influence the adsorption of nanoparticles to supports negatively. The quantitative removal of the ligands is very challenging and accompanied by unwanted side effects like agglomeration. Particular´s laser ablation makes it possible to generate ligand-free nanoparticles that show a 100 times higher adsorption efficiency under ambient conditions without pre or post-treatment of the educts and products.

The absence of ligands improves not only the affinity to carrier surfaces. As a result, no catalytic centers are blocked by ligands, the catalytic activity is significantly increased. That makes Laser-generated nanoparticles immobilized on particulate supports an efficient tool in heterogeneous catalysis.



Adsorption of ligand-coated and ligand-free, laser-generated nanoparticles on support. No calcination or cleaning is required if Particular´s purest nanoparticles are used. Additionally the catalytic activity is more stable.

Advantages of supported laser-generated nanoparticles

- High nano-activity due to the unique properties of the laser-generated nanoparticles and high particle loads up to 30 wt% (even higher loads on request)
- Highest purity: free of residual chemicals
- No pre- or post-treatment of the educts and products necessary
- Many combinations of nanoparticle and support materials (more combinations on request)
- Combination of the unique properties of the laser-generated nanoparticles and the simple handling of the supporting powders

Visit **www.strem.com** for new product information and a searchable catalog.

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Selection Matrix of laser-generated Nanoparticles and support powders

Strem offers a wide range of precious nanoparticles prepared via Laser Ablation in Liquid by Particular GmbH with high defect density adsorbed to powder supports with different mass loads:

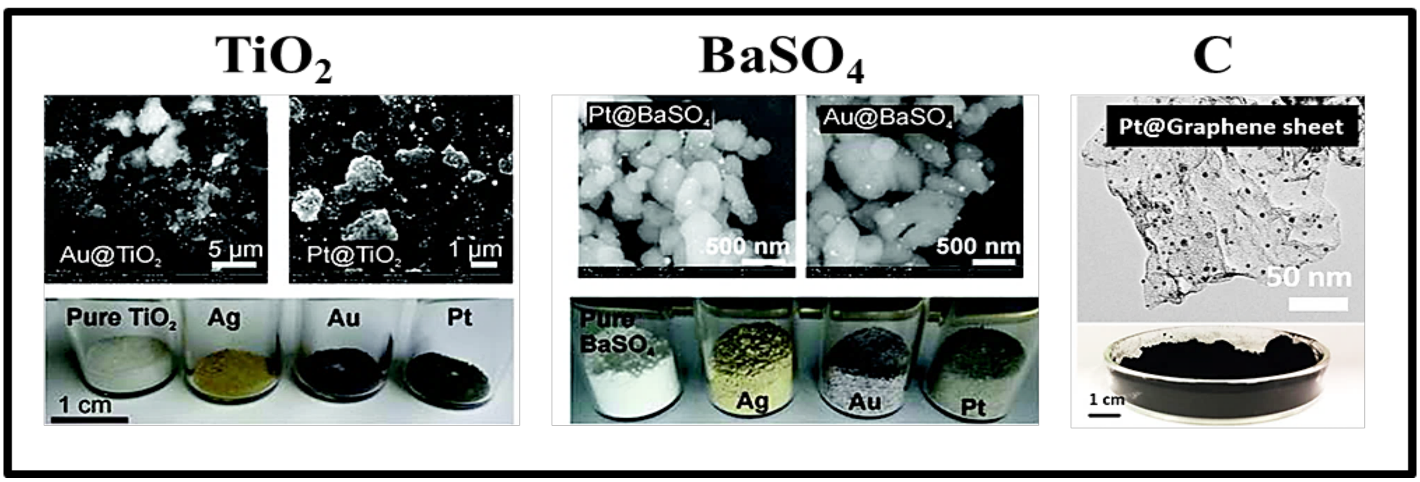
Selection matrix: pick element, support material, mass load (• = available)

Elements	TiO_2					C				
	1 wt%	5 wt%	10 wt%	20 wt%	30 wt%	1 wt%	5 wt%	10 wt%	20 wt%	30 wt%
Au	•	•	•	•	•					
Pt						•	•	•	•	•

<u>Supports are standard materials:</u>

- TiO_2: anatas - or rutil[2] -modification available
- C: Carbon Black, e.g., Vulcan

Other combinations of support materials and elements on request!



Laser-generated nanoparticles (Silver, Gold, Platinum) on carrier materials (TiO_2, $BaSO_4$, graphene or Carbon black)

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[1] TiO_2: Anatase (e.g., Hombicat Type II)
[2] TiO_2: Rutil (e.g., P25)

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Catalog #	Description
79-0921	Gold nanoparticles, 1% on carbon black (surfactant and reactant-free)
79-0916	Gold nanoparticles, 1% on Titania (anatase) (surfactant and reactant-free)
79-0905	Gold nanoparticles, 1% on Titania (anatase/rutile) (surfactant and reactant-free)
79-0926	Gold nanoparticles, 5% on carbon black (surfactant and reactant-free)
79-0935	Gold nanoparticles, 10% on Titania (anatase) (surfactant and reactant-free)
79-0930	Gold nanoparticles, 10% on Titania (anatase/rutile) (surfactant and reactant-free)
78-3015	Platinum nanoparticles, 1% on carbon black (surfactant and reactant-free)
78-3012	Platinum nanoparticles, 1% on Titania (anatase) (surfactant and reactant-free)
78-3005	Platinum nanoparticles, 1% on Titania (anatase/rutile) (surfactant and reactant-free)
78-3020	Platinum nanoparticles, 5% on carbon black (surfactant and reactant-free)
78-3030	Platinum nanoparticles, 10% on carbon black (surfactant and reactant-free)
78-3026	Platinum nanoparticles, 10% on Titania (anatase) (surfactant and reactant-free)
78-3023	Platinum nanoparticles, 10% on Titania (anatase/rutile) (surfactant and reactant-free)
78-3032	Platinum nanoparticles, 20% on carbon black (surfactant and reactant-free)
78-3035	Platinum nanoparticles, 30% on carbon black (surfactant and reactant-free)

References:

Catalyst fabrication:

[1] Wagener, P.; Schwenke, A.; Barcikowski, S.: How Citrate Ligands Affect Nanoparticle Adsorption to Microparticle support. In: Langmuir 28 (2012), pp. 6132-6140

[2] Marzun, G.; Streich, C.; Jendrzej S.; Barcikowski, S.; Wagener P.: Adsorption of Colloidal Platinum Nanoparticles to Supports: Charge Transfer and Effects of Electrostatic and Steric Interactions

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[4] Marzun, G.; Nakamura J.; Zhang X.; Barcikowski S.; Wagener P.: Size control and supporting of palladium nanoparticles made by laser ablation in saline solution as a facile route to heterogonous catalysts.

Catalyst or pigment/filler properties:

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[9] Youtube; Nanofunction; Photocatalytic Water Splitting Catalyst Fabrication by Nanoparticle Adsorption on Titanium Dioxide; 18.02.2014; https://www.youtube.com/watch?v=o3wBcq4CbtI

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