

PERFORMANCE MATERIALS

FOR ADDITIVE MANUFACTURING APPLICATIONS



CABOT 



Introduction

Cabot Corporation is a global performance materials company. We have collaborated with our customers for more than 135 years to solve challenges and drive innovation. Our global reach, world-class research and development facilities and proprietary particle modification technology enable new possibilities for end-product performance.

Additive Manufacturing

Additive manufacturing (AM) is the technological process of building a three dimensional (3D) object, layer by layer, through the use of a computer-enabled design model. AM enables rapid product development, improved product quality, and reduced costs and time to market.

This field is continuing to grow thanks to its convenience and accessibility, which reduces inventory carrying requirements. To realize its full potential, AM must rely on innovative additives that can enable new functions and help improve product quality and performance, as well as process efficiency. We offer several best-in-class products that can enable key performance features for AM applications.

Cabot Products for AM

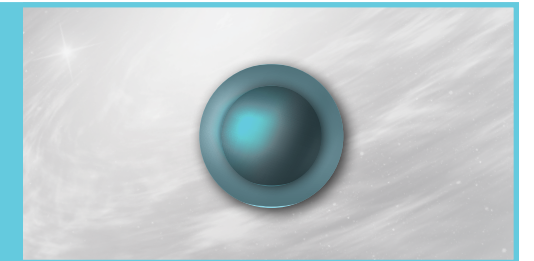
Cabot offers **colloidal** and **composite silica particles** in dry, fluffy form that can be easily dispersed down to the primary particle size. Our **fumed silica** can impart key performance benefits for additive manufacturing across all technologies. We also offer specialty **carbon black** products that can deliver desired pigmentation, resistivity and mechanical properties.

Cabot Products' Performance Benefits

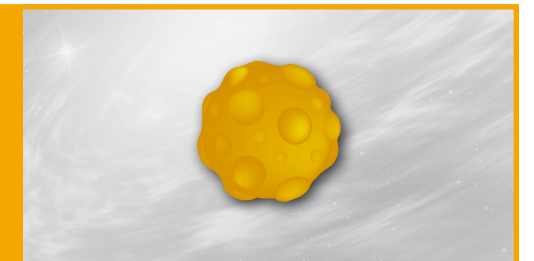
IN STEREOLITHOGRAPHY (SLA) PRINTED PARTS:	<ul style="list-style-type: none"> ◆ Improved mechanical properties ◆ Improved thermo-mechanical properties (higher Heat Deflection Temperature) ◆ Easily dispersible ◆ Viscosity control
IN SELECTIVE LASER SINTERING (SLS) PRINTED PARTS:	<ul style="list-style-type: none"> ◆ Increased powder recyclability ◆ Improved powder flowability ◆ Improved mechanical properties ◆ Energy absorption ◆ Reduced print times ◆ Effective antiblocking agent
OTHER BENEFITS FOR AM PRINTED PARTS:	<ul style="list-style-type: none"> ◆ Black pigmentation ◆ Enable electrical conductivity

Learn more about our product features and benefits by clicking on one of the buttons below.

CAB-O-SIL® TG-C COLLOIDAL SILICA →



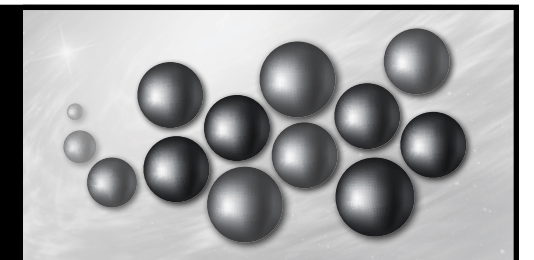
ATLAS™ SILICA COMPOSITE PARTICLES →

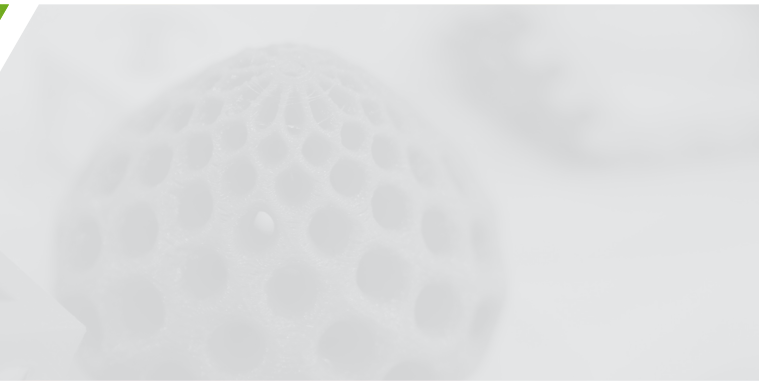
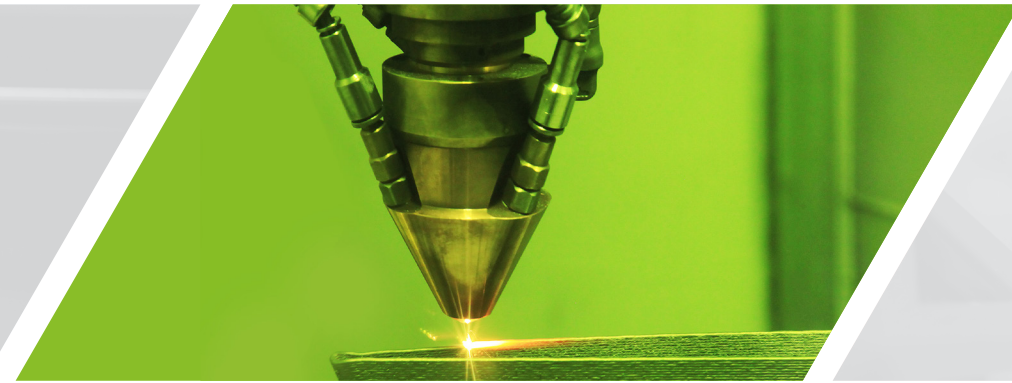
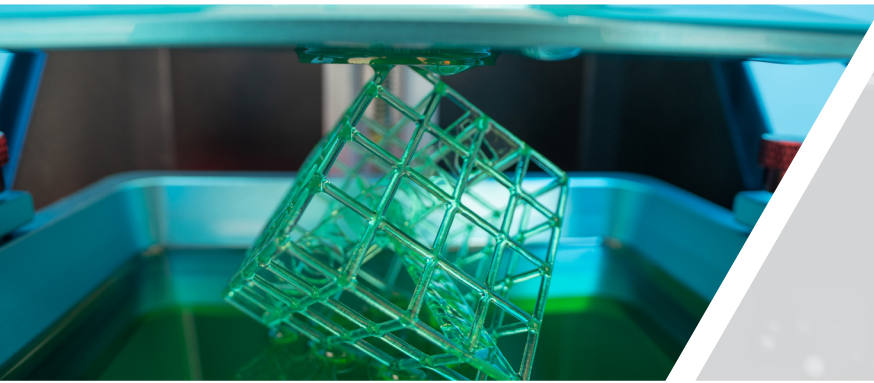


CAB-O-SIL® TG FUMED SILICA →



SPECIALTY CARBON BLACKS →





Stereolithography (SLA) Applications

We offer a variety of colloidal and composite silica products with different particle sizes and surface chemistries for stereolithography additive manufacturing. These products are available in dry powder form and are easily dispersed in resins for SLA. Our composite and colloidal silicas can be dispersed down to their primary particle size to improve the mechanical properties of printed parts with little impact on viscosity. In test formulations, the addition of colloidal or composite particles at 3-15% weight did not result in significant increases in resin viscosity.

We also offer methacryl-silane treated silica particles that can help facilitate cross-linking within acrylate resins commonly used in SLA printing. This treatment promotes improved filler dispersion within the polymeric matrix of the resin formulation and facilitates molecular level mixing between the polymeric chains and the inorganic filler particles, leading to enhanced mechanical and thermo-mechanical properties of printed parts.

Our colloidal and composite silica particles improve the following mechanical properties of SLA printed parts:

- Tensile (modulus, elongation, strength)
- Flexural (modulus, elongation, strength)
- Compression (modulus, strength)
- Heat deflection temperature (HDT)

Our carbon blacks featured in our AM portfolio can provide pigmentation and conductivity for SLA printed items.



SLA printing process

Selective Laser Sintering (SLS) Applications

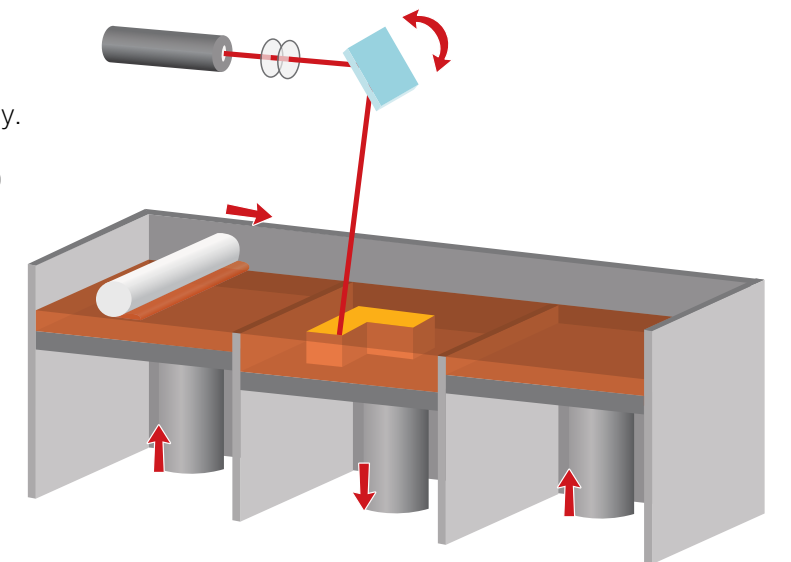
When dry-mixed with polymer powders Cabot's colloidal and composite silica additives are easily dispersed down to primary particles. These particles are excellent spacers that are effective in preventing blocking of soft polymer powders and they increase powder recyclability.

We also offer fumed silica products that can be used to improve the flowability of polymer powders.

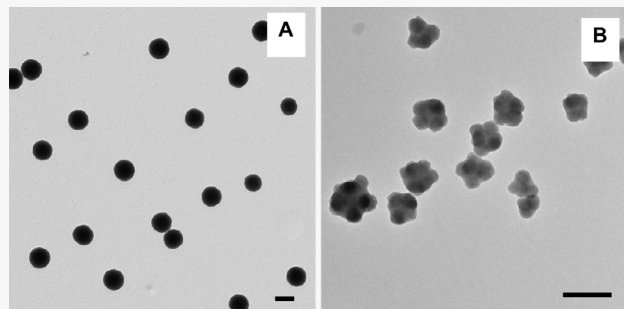
Our silica products have been shown to provide the following performance benefits:

- Powder flowability
- Powder recyclability
- Mechanical preservation of printed parts when fused into polymer particles

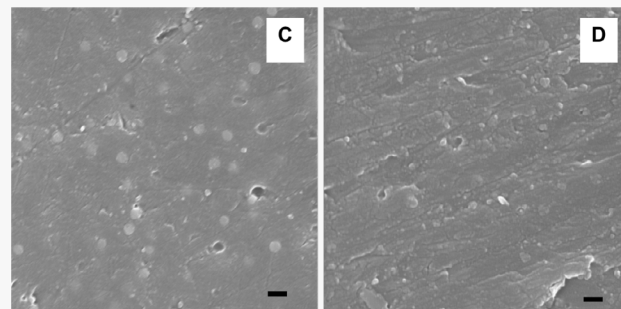
We also feature carbon black that can be used as a free flow additive and can help focus the lasers used in SLS to allow for more rapid printing of final articles.



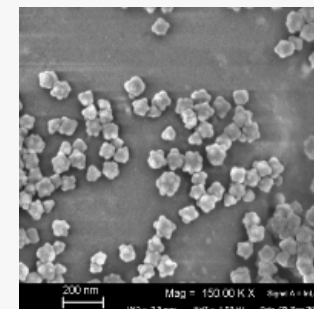
SLS printing process



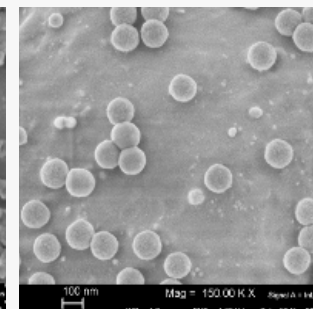
TEM images of representative colloidal silica (A) and silica-composite (B) particles. Scale bars correspond to 100 nm.



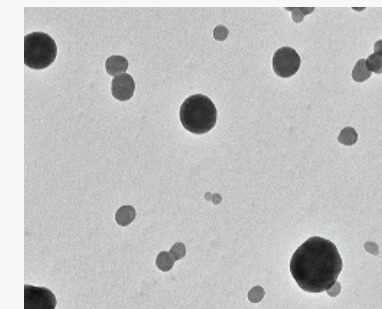
SEM images of printed parts surfaces illustrating good dispersion of colloidal (C) and composite particles (D). Scale bars correspond to 200 nm



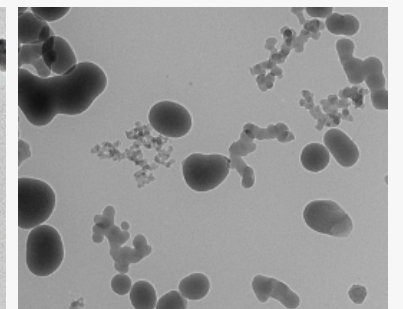
SEM image of ATLAS™ silica particles dispersed on the surface of polymer powder



SEM image of CAB-O-SIL® colloidal silica dispersed on the surface of polymer powder



Our specialty carbon blacks feature individual spherical particles and a narrow particle size distribution



CAB-O-SIL fumed silica features aggregated particles and a wide particle size distribution

Product Selection

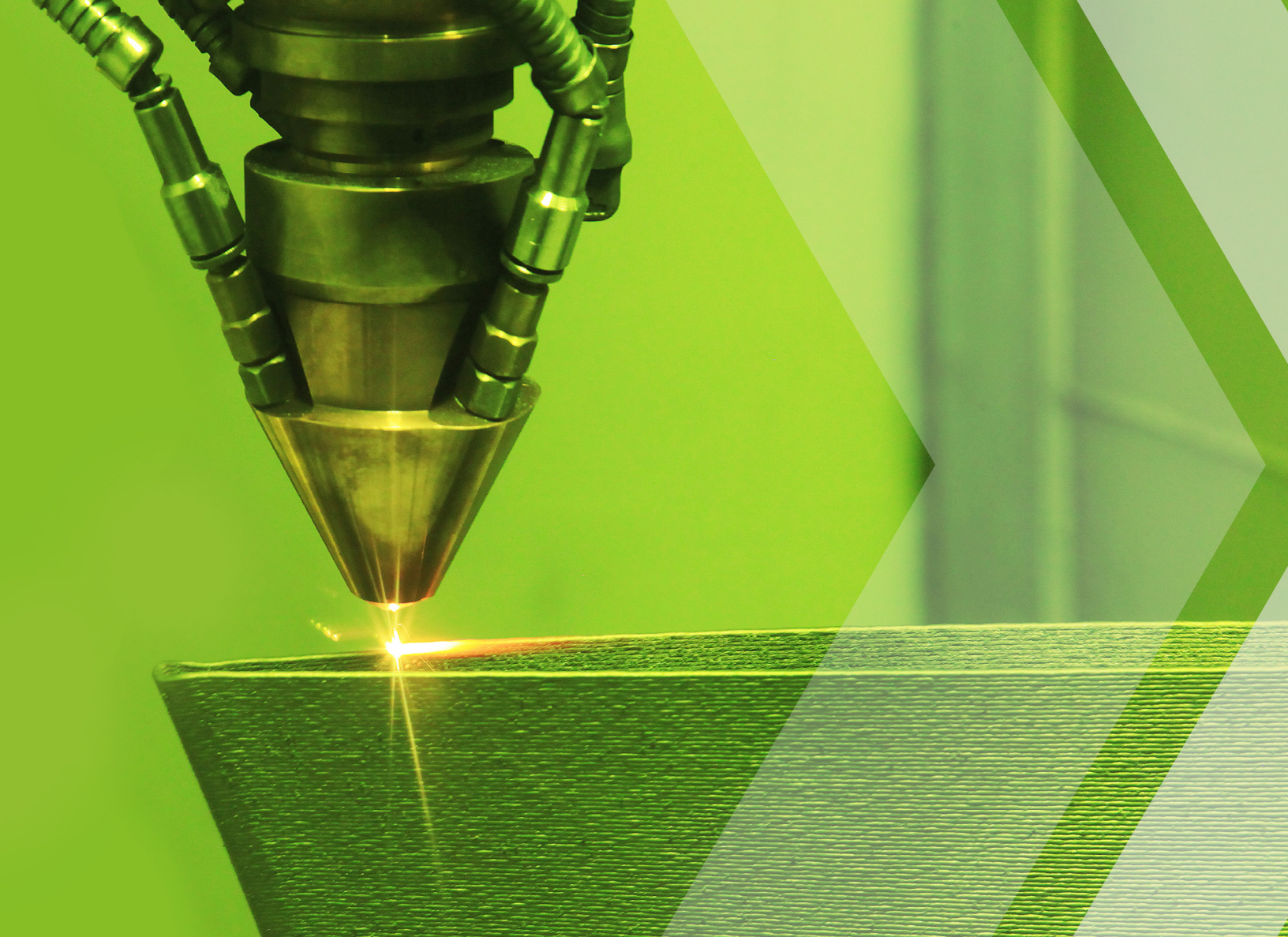
Cabot Silica and Composite Particle Products

PARTICLE CHARACTERISTICS				PRIMARY FUNCTION				
Silica Product	Type	Treatment	Primary particle size (nm)	Free flow	Rheology control	Mechanical reinforcement	Spacing	Powder recyclability
CAB-O-SIL® TG-820F	Fumed	Cyclic/TMS	8	◆	◆	◆		
CAB-O-SIL TG-612F	Fumed		23	◆	◆	◆		
CAB-O-SIL TG-7120	Fumed		18	◆	◆	◆		
CAB-O-SIL TG-709F	Fumed	DiMeDi	18	◆	◆			
CAB-O-SIL TG-5180	Fumed	PDMS	37	◆	◆	◆	◆	
CAB-O-SIL TG-308F	Fumed		12	◆	◆	◆		
CAB-O-SIL TG-5110	Fumed	TMS	37	◆	◆	◆	◆	
CAB-O-SIL TG-811F	Fumed		8	◆	◆	◆		
CAB-O-SIL TG-C390	Colloidal	Alkoxysilane	65	◆		◆	◆	◆
CAB-O-SIL TG-C191	Colloidal		115			◆	◆	◆
TPX-5110	Colloidal	Methacrylate	115			◆		
CAB-O-SIL TG-C110	Colloidal	TMS	115	◆		◆	◆	◆
CAB-O-SIL TG-C413	Colloidal		50	◆		◆	◆	◆
TPX-5101	Composite	Methacrylate	85			◆		
ATLAS™ 100	Composite	TMS	85	◆		◆	◆	◆

Cabot Carbon Black Products

PARTICLE CHARACTERISTICS			PRIMARY FUNCTION				Notes
Product	Surface chemistry	Particle treatment	High resistivity	High light shielding	Low impact on viscosity	Low UV adsorption	
TPK-1227R	Hydrophilic	◆	◆	◆	◆		◆ Promotes polymer fusing, powder recyclability and mechanical properties in SLS ◆ Provides pigmentation and high resistivity with low impact to viscosity in SLA
TPK-1104R	Hydrophilic	◆	◆	◆	◆		◆ Provides comparable performance to TPK-1227R specialty carbon black, but with lower resistivity and light shielding
MOGUL® E	Moderately hydrophilic	◆				◆	◆ Provides comparable performance to TPK-1227R specialty carbon black, but with lower resistivity and larger impact to viscosity ◆ Lower UV adsorption will positively impact curing
TPK-1099R	Hydrophobic				◆		◆ Provides comparable performance to TPK-1227R specialty carbon black, but with lower resistivity and light shielding ◆ More compatible with hydrophobic polymers
REGAL® 85	Hydrophobic				◆	◆	◆ Similar to TPK-1099R, but lower light shielding; minimal interference with UV curing process

For more information on Cabot's products for additive manufacturing applications, contact your Cabot sales representative or visit cabotcorp.com/AM.

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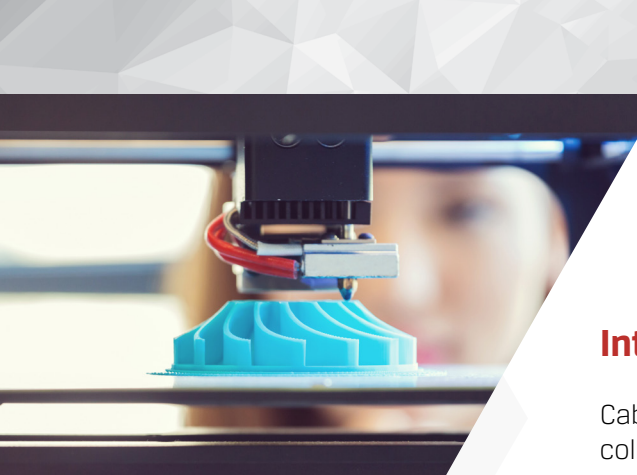
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Cabot Products' Performance Benefits

IN STEREOLITHOGRAPHY (SLA) PRINTED PARTS:	<ul style="list-style-type: none"> ◆ Improved mechanical properties ◆ Improved thermo-mechanical properties (higher Heat Deflection Temperature) ◆ Easily dispersible ◆ Viscosity control
IN SELECTIVE LASER SINTERING (SLS) PRINTED PARTS:	<ul style="list-style-type: none"> ◆ Increased powder recyclability ◆ Improved powder flowability ◆ Improved mechanical properties ◆ Energy absorption ◆ Reduced print times ◆ Effective antiblocking agent
OTHER BENEFITS FOR AM PRINTED PARTS:	<ul style="list-style-type: none"> ◆ Black pigmentation ◆ Enable electrical conductivity

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CAB-O-SIL® TG-C COLLOIDAL SILICA



Product Features:

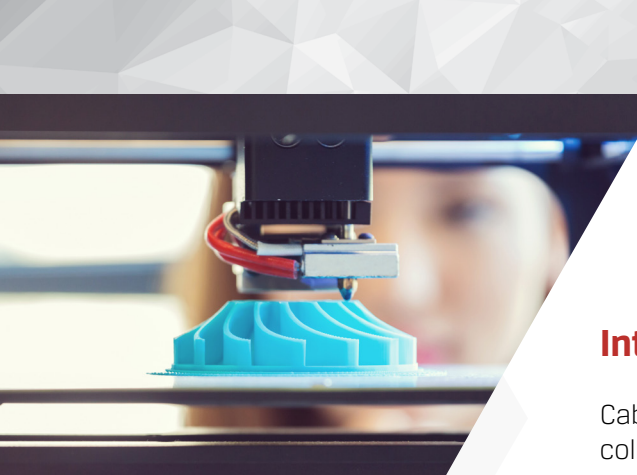
- ◆ Has a spherical or oblong shape with a relatively uniform particle size distribution
- ◆ Dry, fluffy hydrophobic powders easily dispersed in acrylate/methacrylate resins
- ◆ Disperses down to primary particle size, which facilitates an ease of handling and high dispersion without increasing viscosity
- ◆ Product line features grades with mean particles sizes ranging from 50 to 200 nm (BET surface area from 55 m²/g to 30 m²/g)

Benefits for SLA

- ◆ Provides a spacing effect that helps preserve the function of other external additives, even under harsh mixing conditions that would otherwise lead to decreased performance
- ◆ Improved mechanical properties
- ◆ Improved thermo-mechanical properties

Benefits for SLS

- ◆ Improved powder free flow
- ◆ Improved powder recyclability
- ◆ Improved mechanical properties of printed parts



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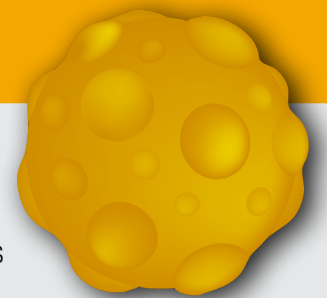
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Learn more about our product features and benefits by clicking on one of the buttons below.

ATLAS™ SILICA COMPOSITE PARTICLES



Product Features:

- ◆ Feature a unique spheroid shape, which enables easy dispersion and even suspension in resin formulations
- ◆ Dry, fluffy hydrophobic powders easily dispersed in acrylate/methacrylate resins
- ◆ Disperses down to primary particle size, which facilitates an ease of handling and high dispersion without increasing viscosity
- ◆ Comprised of lightweight silica and polymer with a diameter of approximately 100 nm

Benefits for SLA

- ◆ Provides a spacing effect that helps preserve the function of other external additives, even under harsh mixing conditions that would otherwise lead to decreased performance
- ◆ Improved mechanical properties of final articles
- ◆ Improved thermo-mechanical properties of final articles

Benefits for SLS

- ◆ Improved powder free flow
- ◆ Improved powder recyclability
- ◆ Improved mechanical properties of final articles



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CAB-O-SIL® TG FUMED SILICA



Product Features:

- ◆ Small primary particles fused together to form highly structured aggregates
- ◆ Sold as dry, fluffy powder that is easily dispersed in acrylate/methacrylate resins
- ◆ Further post-processed to achieve a consistent agglomerate size, which can lead to improved AM powder performance and consistency
- ◆ Mean primary particle sizes from 8 to 40 nm (BET surface area from 325 m²/g to 60 m²/g).

Benefits for SLA

- ◆ Improved mechanical properties of final articles
- ◆ Improved thermo-mechanical properties of final articles
- ◆ Improved powder free flow

Benefits for SLS

- ◆ Improved powder free flow
- ◆ Improved powder recyclability
- ◆ Improved mechanical strength



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SPECIALTY CARBON BLACKS

Cabot offers five carbon black grades for AM applications.

These products feature:

- ◆ A low structure and large particle size
- ◆ Low viscosity
- ◆ Hydrophilic and hydrophobic surface chemistries
- ◆ High to low relative resistivity
- ◆ High to low light shielding properties
- ◆ High to low energy adsorption

Benefits for SLA

- ◆ Pigmentation
- ◆ Conductivity
- ◆ Low viscosity impact

Benefits for SLS

- ◆ Improved powder free flow
- ◆ Can help focus laser to allow for more rapid printing
- ◆ Promotes polymer fusing
- ◆ Promotes powder recyclability
- ◆ Improves mechanical properties of final articles

