QUESTEK® INNOVATIONS LLC

Focused on designing and deploying best-in-class novel materials

QuesTek *Materials by Design*® methodology is based on Integrated Computational Materials Engineering (ICME) technologies that benefit producers, processors, OEMs and end-users by minimizing risks associated with alloy development, reducing research costs, and cutting in half the time to market with least overall life cycle cost. We design higher performance materials to meet specific property goals, such as:

- Tensile Strength
- Fracture Toughness
- Corrosion Resistance
- High Temperature Resistance
- Wear Resistance
- Fatigue Strength
- Processability
- Resistance to Hot Tearing

These materials are designed to yield benefits such as lower operating & maintenance costs, smaller/lighter/reliable components, and patent-protected competitive advantages.

QuesTek Additive Manufacturing

Recognizing that the use of traditional wrought/cast alloys for Additive Manufacturing (AM) processing has limitations, we apply ICME technologies to design the specific alloy chemistry needed for AM processes to ensure optimum properties.

Ongoing AM Projects at QuesTek

DARPA Rapid Low Cost AM

DARPA Open Manufacturing with Honeywell
Calibration and validation of models within ICME framework to accurately predict microstructure and properties of Ni 718+ superalloy components produced using DMLS

ICME Development for AM Aerospace Components

Subcontract under Honeywell-Metals Affordability Initiative Development of microstructure and property models for high-temperature Ti- and Ni-based alloys process by AM

Computational Design of Aluminum Alloys for Use in AM

New class of 7050-T74 Al alloys with improved strength and hot cracking resistance
(2015 Navy SBIR Phase I, Topic N151-010)
Four unique Al alloys covering a range of strategies for enhanced performance and AM processability
(2015 ONR SBIR Phase II, Topic N141-062)

QuesTalloy™ Ti-6-4 Mod alloy for AM

Lower cost, greater strength and toughness vs. legacy Ti-6-4
Lockheed-funding for AM builds at Sciaky, presentation at AeroMat in May, 2016
(2008 Army Phase I SBIR, Topic A082-050)

Application of ICME to Optimize Processing of State-of-the-Art Gear Steels in AM

Atomization of *Ferrium*® C64® steel and demonstration of Laser Engineered Net Shaping (LENS) AM builds for aerospace gears
(2017 Army SBIR Phase II, Topic A15-104)

Exploratory Tungsten AM Study: Ductile-Brittle Transition Modeling

Development of a DBTT model to account for embrittlement in AM tungsten
Partnering with NIU / Federico Sciammarella

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QuesTek Additive Manufacturing

U.S. Navy/ONR Funded SBIR/STTR Program

Optimized High Performance Stainless Steel Powder for Additive Manufacturing
Development of a new powder specification for 17-4PH stainless steel, optimized specifically for selective laser melting (SLM) technologies
(Navy STTR Phase II, Topic N16A-007)

Integrated Computational Material Engineering (ICME) Tool Set for Additive Manufacturing of Stainless Steel (316L)
Development of an "Integrated Model Toolkit" that enables the modeling of AM process by predicting local composition, microstructure, residual stresses, and mechanical properties for 316L stainless steel aerospace components
(ONR STTR Phase I, Topic N16A-022)

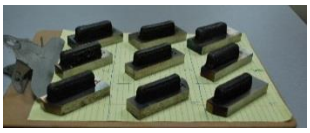
Additive Manufacturing Development of Naval Platform Heat Exchangers
Creation of new ICME tools and models that will allow for an intelligent selection of appropriate materials for the AM of heat exchange components
(Navy SBIR Phase I, Topic N161-071)

Quantifying Uncertainty in the Mechanical Performance of Additively Manufactured Parts Due to Material and Process Variation
Extension of the Accelerated Insertion of Materials (AIM) framework for managing the uncertainty in the mechanical performance of laser power bed AM Ti-6-4 materials
(Navy STTR Phase I, Topic N16A-004)

QuesTek Alloys Nearing Commercial Availability for AM

- Strength and toughness upgrade over Ti-6-4
  - Processed by Sciaky EBAM AM process
- High-strength, precipitation-hardenable aluminum alloys
  - Optimized for DMLS, processable without hot cracking
  - 7000 and 5000 series designed for strength and corrosion resistance, respectively
- Best-in-class carburizable *Ferrium*® C64® gear steel
  - Being optimized for LENS AM of gears for aerospace applications
- High-strength, high toughness stainless steel (*Ferrium* PH48S™)
  - Developed for LENS AM process

QuesTek Ti-6-4 Mod build at Sciaky with Lockheed Martin



Initial LENS deposition trials for *Ferrium* C64

Contact Jeff Grabowski, Mgr of Applications and Prod. Commercialization at 847-425-8241 for more info