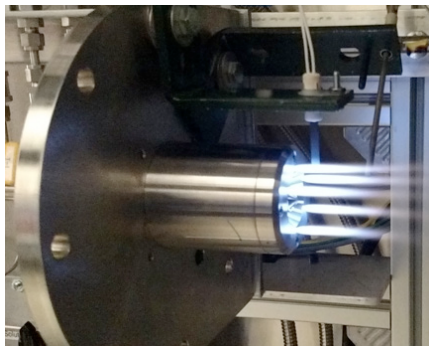


ENABLING FLAME SPRAY PYROLYSIS FOR MANUFACTURING COMPLEX CATALYSTS IN HIGH VOLUMES



Argonne's FSP facility

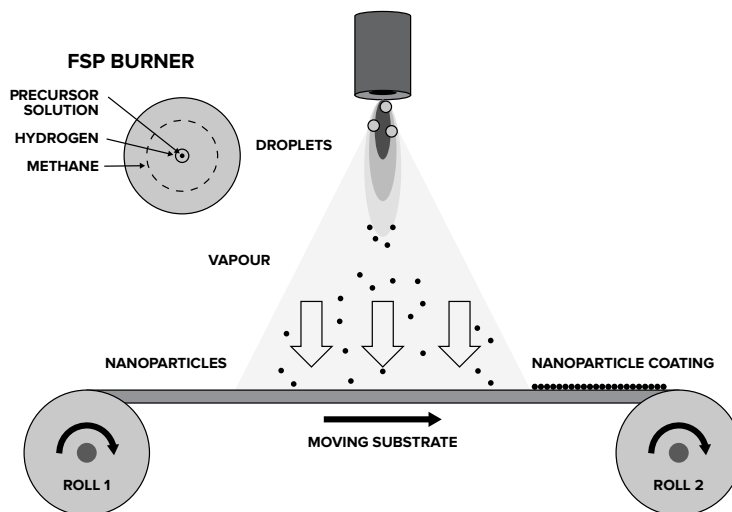
OVERVIEW

New complex materials and predictive manufacturing processes to optimize quality control can be designed by leveraging Argonne National Laboratory's world-class in-situ diagnostics, computer modeling, scale-up technology and expertise in combustion engineering, aerosol and materials sciences. Benchmarking materials and FSP processes by combining particle morphology and combustion diagnostics will enable manufacturers to control the chemical and physical properties during production that determine catalysis performance.

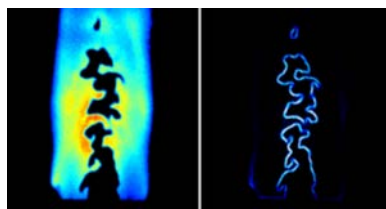
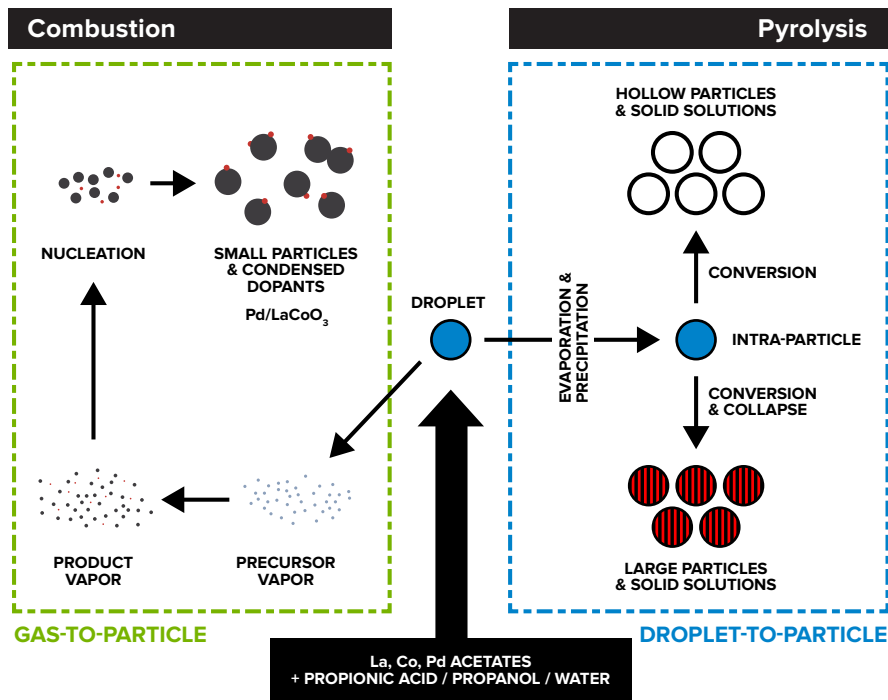
INDUSTRIAL BENEFITS OF FSP COMPARED TO WET CHEMISTRY-BASED PROCESSES

- Low-cost production
- Low precursor material cost (e.g. metal salts)
- Rapid, scalable production of materials
 - Only way to produce materials with unique physicochemical properties
 - Fewer and less time-consuming production steps
 - Continuous process
 - Reproducible catalyst morphology
- Direct deposition moving substrate in roll-to-roll manufacturing
- Produces nanometer monolithic particles instead of porous micron-sized particles
- Ability to make new materials, such as ODH propane, because of greater control of catalysis composition.
- Unique material morphologies such as core-shell structures and nanorods are possible

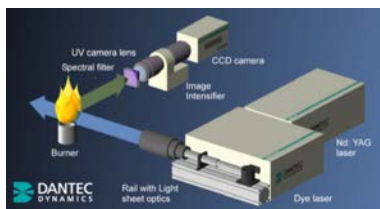
FSP Process



Catalyst manufacturing using FSP with roll-to-roll technology dramatically reduces costs by reducing production steps.



OH Species



Example PLIF System

CUTTING-EDGE FLAME SPRAY PYROLYSIS RESEARCH AND DEVELOPMENT IN THE U.S.

Capabilities

- Suite of world-class laser in-situ and ex-situ diagnostics systems. (2018 build out)
 - 2d chemical species and flame temperature distribution
 - Real-time measurement of particle sizes from 5 nm to 1 μm
- X-ray Imaging and characterization at the nation's highest-energy synchrotron light source
- Catalysis characterization at Argonne's High Throughput Research Laboratory
- Fundamental combustion science expertise
- Manufacturing Engineering Research Facility (MERF) has flexibility for Flame Assisted Spray Pyrolysis (FASP) or Flame Spray Pyrolysis (FSP)
 - 20 grams/hour production
 - Daily operation turnover
- Ability for future advanced burner development
- In-house suite of synthesized families of catalysts with unique morphologies for use in benchmark testing

COLLABORATORS



Offen im Denken



COLLABORATE WITH US

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