

Advanced nanoparticles synthesis by laser pyrolysis for energy production and storage

Yann Leconte

▶ **To cite this version:**

Yann Leconte. Advanced nanoparticles synthesis by laser pyrolysis for energy production and storage. Nano S&T, Oct 2017, Fukuoka, Japan. cea-02341033

HAL Id: cea-02341033
https://cea.hal.science/cea-02341033

Submitted on 31 Oct 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Title: Advanced nanoparticles synthesis by laser pyrolysis for energy production and storage

Dr. Yann Leconte
Researcher
CEA Saclay
France

Abstract

Urging demand for efficient technologies aiming at fossil fuel replacement drives the development of innovative materials and motivates abundant research work. In particular, advanced nanostructured materials, because of their peculiar properties due to size effects, appear as smart and efficient solutions to meet this challenge. In this context, novel processes able to synthesize advanced nanoparticles play a key role in the achievement of innovative devices for alternative energy production and storage. In this lecture the development of laser pyrolysis process is reported in the fields of photovoltaics and electrochemical storage.
Laser pyrolysis is a gas phase flow process enabling the synthesis of various nanoparticles using a laser beam for precursors thermal decomposition. Because of flow operation and small dimension of focused laser spot, the residence time and growth duration after nucleation is very short, leading to the collection of very small nanoparticles. In the case of silicon quantum dots, particles as small as 3 nm can be obtained which exhibit quantum confinement with broadened bandgap. Such materials can be doped and deposited in situ, together with the co-deposition of a matrix using sputtering, in order to elaborate nanostructured or nanocomposite thin films. In this process, sources of particles and matrix are separated and independent, leading to a high versatility in terms of composites composition. The Si bandgap engineered films prepared with this laser pyrolysis based in situ deposition technique were proven to show interesting electronic and optical properties for high efficiency solar cells application based on all-Si tandem cells. For energy storage, SnO_2 or $ZnFe_2O_4$ nanopowders can be synthesized from liquid precursors with various morphologies or doping elements. When applied as conversion materials for batteries, these particles show state of the art performances versus Li with very good cyclability. Si@C core-shell structures can also be prepared in a single step thanks to a double stage laser pyrolysis reactor, where Si cores are grown at the first stage before being covered by carbon at the second stage. With this process the nature of the core particle can be chosen independently of the coating nature. Obtained structures can then be used as alloying materials electrodes in Li batteries, showing highly improved cyclability for Si-based batteries.

Biography

Dr. Yann Leconte is a researcher in French alternative energies and atomic energy commission (CEA), working in the Saclay institute of matter and radiation (IRAMIS) of the fundamental research division. He works in particular in the nanosciences field in NIMBE (Nanosciences and Innovation for Materials, Biomedicine and Energy). His main research topics deal with nanomaterials development for energy applications using laser pyrolysis and thermal plasma processes.
After earning a master degree in physics, he obtained his PhD in materials sciences in Lower Normandy University (France) in 2003. After two years of post-doctoral fellowship in CEA, he finally got a permanent researcher position in 2005. Since then he was principal investigator or co-investigator of several CEA and French national research agency projects. He is the author of 50 peer-reviewed papers and inventor in 5 patents. He is also the president of the "Powders and sintered materials" commission related to French materials societies.