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Successful R&I in Europe 2026 - 13th European Networking Event

Plasma Technology for Circular Economy: Processing of end-of-use PV Silicon for Industrial Application

Tim Hülser, Division Particle Process Technology and Characterization

Institut für Umwelt & Energie, Technik & Analytik e. V. (IUTA)

Institute for Environment & Energy, Technology & Analytics

An-Institut der
UNIVERSITÄT
DUISBURG
ESSEN

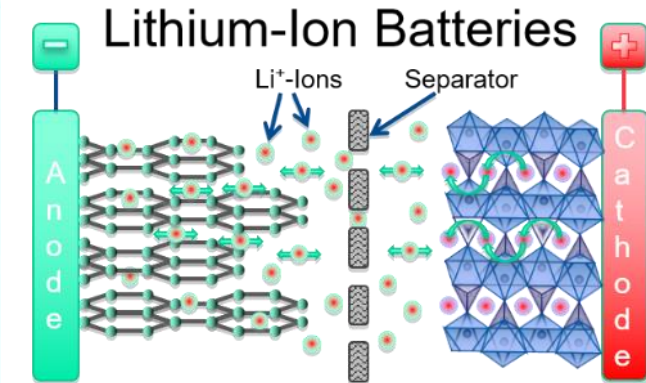
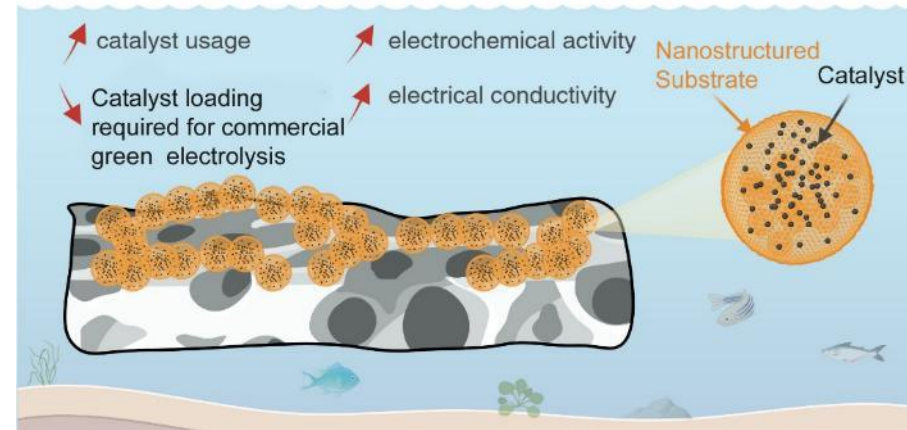


MITGLIED Johannes-Rau-
DER Forschungsgemeinschaft

1. Energy Technologies

- Catalysis (electrolyzers, fuel cells)
- Energy Storage (batteries)
- Energy Harvesting (thermoelectrics)
- Energy conversion (photovoltaics)

Electrolysis



2. Materials and Circular Economy (Project contributions)

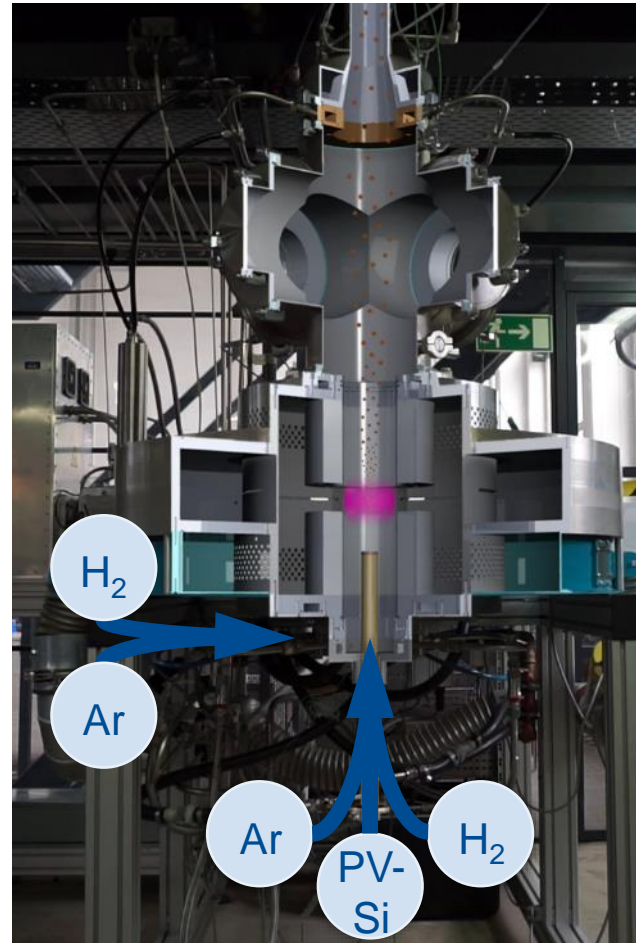
- Feeding of customized powder materials (e.g., from PV applications)
- Conditioning of micro-scale materials in gas phase reactors
- Multinary material systems from customized powders
- Production of nanoscaled alloy particles from end-of-use material
- Definition of applications for circular economy use



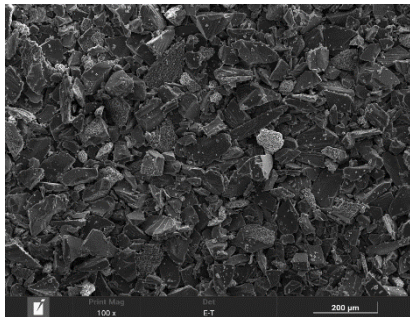
PV-Si recycling material (FLAXRES)



gravimetric powder feeding system



Plasma reactor



25 bis 80 μm

Starting point:

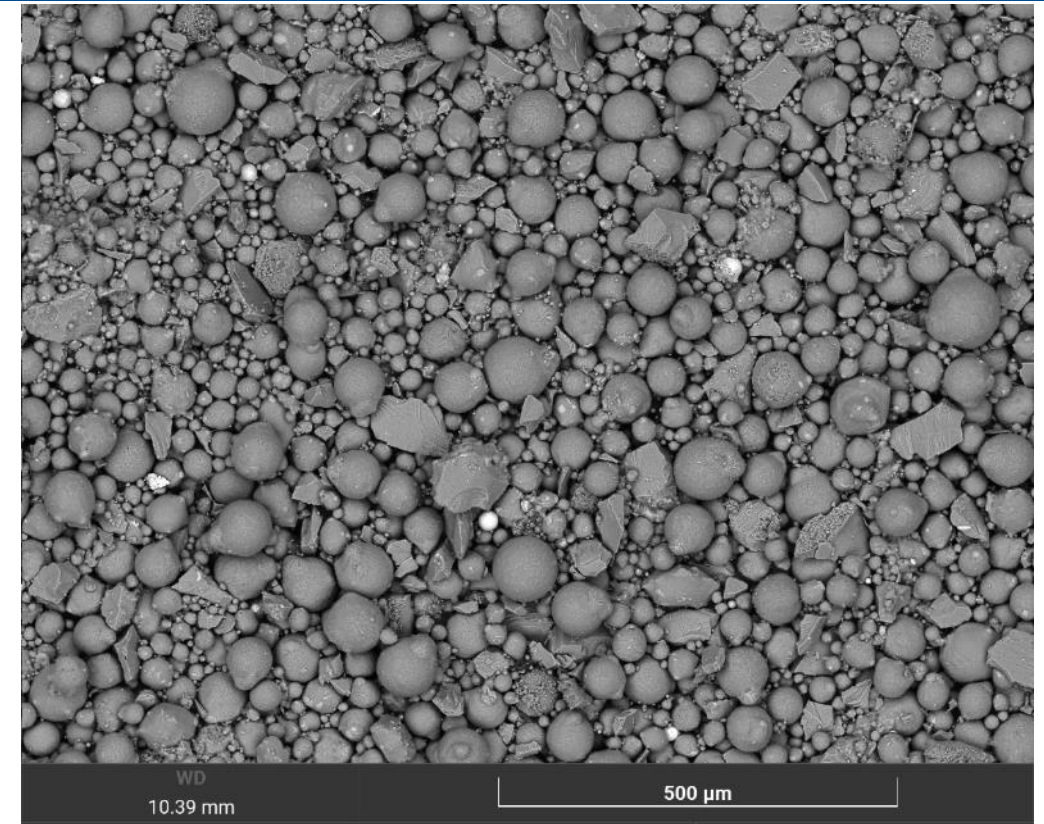
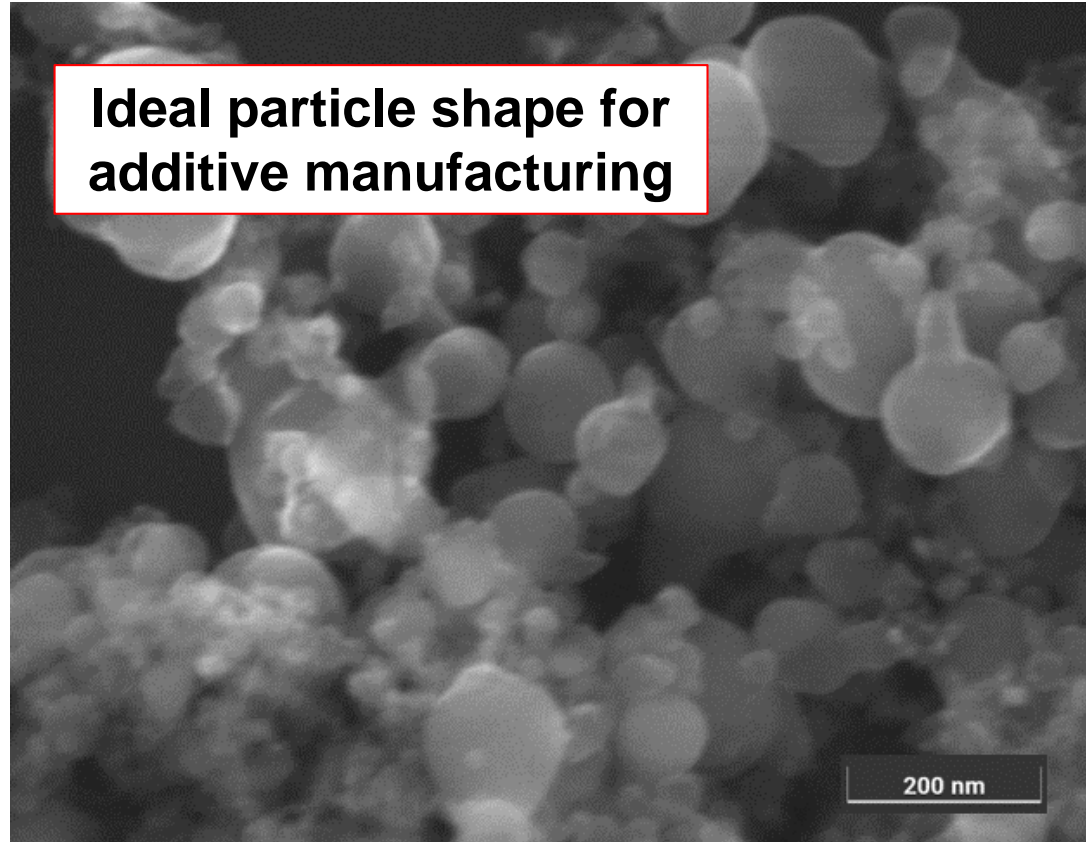
different silicon waste materials

⇒ PV-Si from FLAXRES

- Contamination with silver and alumina due to grid lines & backside contacts
- Additive Manufacturing requires size reduction and **shape homogenization**
- Fragmentation and sieving process

Synthesis in Microwave Plasma Reactor

- Microwaves: 2,45 GHz with up to **50 kW**
- 2 Nozzles (solid/gas)
- atmospheric Ar/H₂ plasma



Residence time study by varying volume flow through inner nozzle:

- 5 slm (longer residence time)



- 22 slm (shorter residence time)
- rounded particles ($d_{CMD} = 22 \mu m$)



Oxides

- Perovskites (LSM,...)
- Titania (doped/undoped, special phases)
- Specific Iron oxides (Spinelles)
- Semiconducting oxides

Non- Oxides & Composites

- Si, doped and un-doped
- Si @ C, SiC
- Si doped SiO₂ (Si Quantum dots)
- Graphene
- FeSi₂
- Core Shell Systems (Fe@Fe₂O₃)

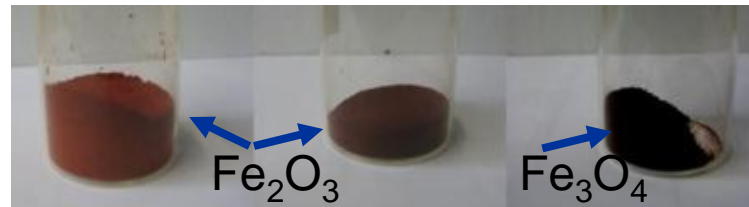
Analytcs: Powder

- REM with integrated RAMAN
- BET
- FTIR
- Impedance measurement
- Luminescence Analysis

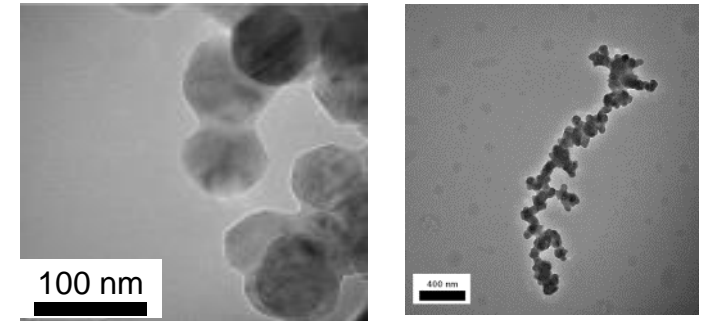
Pilot-plant for nanomaterial synthesis



Iron oxide nanoparticles



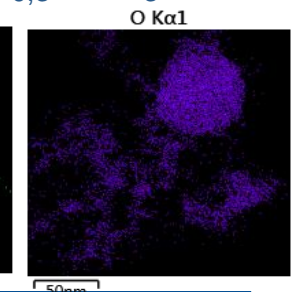
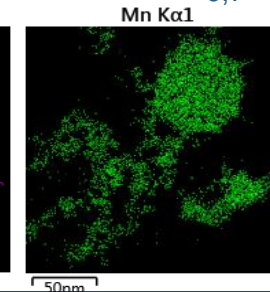
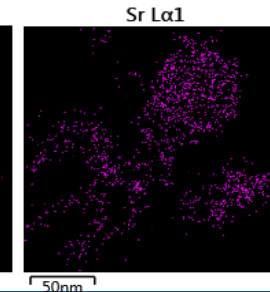
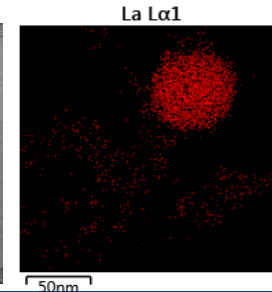
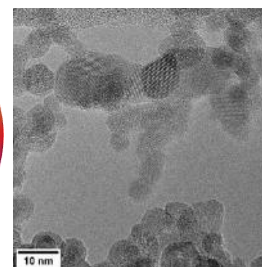
Si- nanoparticles



TiO_{2-x} and TiO₂- nanoparticles



Lanthan-Strontium-Manganese oxide – nanoparticles : La_{0,7}Sr_{0,3}MnO₃



IUTA contributes

- Cover research and new standards for functional nanoparticles
- material supplier with the focus to perform experiments on the pilot plant scale
- provide sufficient material amounts for industrial testing and development.
- All energy related topics including the use of nanomaterials are an option to participate.

New partners searched:

- Research partners (industry and university) in the field of application of functional nanomaterials synthesis,
- Application partners (companies), that are interested to bring our developments to the market

IUTA, experiences:

- NanoFASE, 4 years, 2015-2019 (H2020)
- BIORIMA, 4 years, 2017-2021 (H2020)
- FutureNanoNeeds, 4 years, 2014-2017 (FP7)
- AirMonTech, 4 years, 2010-2014
- Nanodevice , 4 years, 2008-2012
- NanoImpactNet, 4 years, 2008-2012
- EnerGEO, 4 years, 2009-2013
- NETZ- Nanomaterials for Energy Applications, 4 years, 2009-2013

Contact us at: huelser@iuta.de, www.iuta.de