

Fuel Cell Systems using Ammonia

as Renewable Energy Carrier for Future Hydrogen Economies

Michael Steffen

Successful R&I in Europe 2018
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Facts

- Research and development: fuel cells, hydrogen and battery technology
- Focus on industry demand
- Independent service provider and R&D partner
- Share holder: University of Duisburg-Essen
- ~ 80 full time employees + 20 students

Infrastructure

- 1200 m² laboratory
 - Flexible test benches
 - Advanced measurement and analytics
 - Chemical laboratories
- Modern CAE & Simulation tools
- 500 m² technical center / production technologies
 - Injection molding/compound laboratory
 - Gasket production site
 - Mechanical workshop



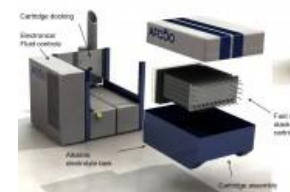
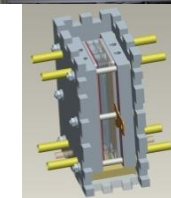
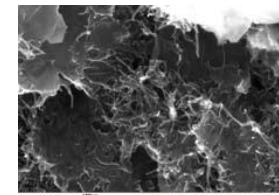
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Examples of Funded European Projects

- **SAPHIR** - Safe, integrated & controlled production of high tech multifunctional materials and their recycling - FP6 (2006-2010)
- **HyRIS** - Development of a combined Hydrogen and Power production system with High Temperature PEM fuel cells - Eurostars Eureka (2010-2012)
- **LiquidPower** - development of fuel cell systems and hydrogen supply for early markets - FP 7 JTI JU (2012-2015)
- **IRMFC** - Development of a portable internal reforming Methanol high temperature PEM Fuel Cell System - FP 7 JTI JU (2013-2016)
- **Alkammonia** - Ammonia-fueled alkaline fuel cells for remote power applications - FP 7 JTI JU (2013-2018)
- **Power-UP** - Demonstration of 750 kW_e alkaline fuel cell system with heat capture - FP 7 JTI JU (2013-2016)
- **SOLIDPOWER** - High-efficiency cogeneration system core for residential CHP applications - ZIM / Eureka (2013-2016)
- **D2Service** - Design of 2 Technologies & Applications to Service - HORIZON2020 (2015-2018)
- **SUPERSURF** - Super precision Surface Measurement System for Fuel Cells - Interreg V / ROCKET (2016-2018)
- **HYDRAITE** - HYdrogen Delivery Risk Assessment and Impurity Tolerance Evaluation - HORIZON2020 (2018-2021)
- **GRASSHOPPER** - GRid ASsiSting modular HydrOgen Pem PowER plant - HORIZON2020 (2018-2021)



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Idea

- Development of fuel cell system with ammonia cracker and LT-PEMFC

Relevance in future carbon free energy system

- Intermittent renewable electricity can be stored via hydrogen in ammonia (“green ammonia”)
- Worldwide ammonia storage, distribution and usage is state of art technology
- Carbon and emission free generation of power, heat and cooling out of ammonia by fuel cell systems
- Multiple applications like backup power for telecommunication, decentralized power generation and/or CHP especially in rural areas





- **EU FCHJU project:** ALKAMMONIA (2013 – 2018)
- **Technology:** catalytic ammonia cracking combined with alkaline fuel cell
- **Application:** telecom industry
- **Research & Development:**
 - catalyst qualification, kinetic investigations, long term testing
 - laboratory cracker for proof of concept
 - prototype for integration with fuel cell and control
 - safety of ammonia system





- **Optimization of fuel supply and cracker system**
 - University/Institute for ammonia cracking catalyst optimization
 - SME for plant engineering and certification (regulation, codes and standards)
- **Ammonia scrubber development**
 - University/Institute and/or SME
- **LT-PEMFC**
 - SME for supply, optimization and operation of PEM fuel cell
- **Complete fuel cell system**
 - SME for systems integration incl. control, assembly, certification
- **Application**
 - Companies with applications for decentralized power supply for real life testing

Many project ideas for cooperation in

- Electrolysis
- Low-carbon hydrogen production
- Hydrogen storage and refueling stations
- Fuel cell technology
- Sector coupling by Power to Gas technologies



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