

# iv2splus INFONET

## Fahrzeugtechnologien, MdZ 5. Call (2014)

### MeStREx

#### Metallischer Stack für Range Extender

Low range of current battery vehicles and therefore limited usability for many potential customers is a highly discussed topic and also for sure an important reason for the low market share of electrical vehicles. For the presented project proposal, a consortium of two technology front running companies (AVL List GmbH and Plansee SE), two well-established academic institutes (TU Graz ICVT and IWT) together with a highly innovative small company (PhysTech Coating GmbH) and a global player in the automotive sector (Nissan Motors Limited) was built in order to find a novel way to solve range limitations. Based on Solid Oxide Fuel Cells (SOFC) with a metallic support, the development of a system which directly can use hydrocarbon fuels (e.g. ethanol) for efficient electrical power generation will be started researched. This system will be used to continuously recharge the vehicle battery pack for range extension (Range Extender) with an efficiency which is far beyond the typical efficiency of other range extender concepts.

The planned project MeStREx (Metallic Stack for Range Extender) addresses as a lighthouse project the topic vehicle technologies with the focus on hydrogen and fuel cells. Electrical vehicles can be seen as a highly attractive alternative to conventional ICE vehicles, but they suffer from low range compared to fuelling and from long charging cycles, which makes them not customer friendly. Innovative range extender systems are considered to be an option for the exploitation of new markets. In the framework of the planned Project "MeStREx", a highly efficient range extender system based on Solid Oxide Fuel Cell technology capable for CO<sub>2</sub> neutral hydrocarbons based on ethanol will be developed. Starting from scratch, a first approach 5 kW System will be considered in order to gather more knowledge about the potential for technical realization of such technology. For a later product development, target power is expected to be in the range of 30 kW.

In order to guarantee a focussed development, the work package "WP1 Specifications" was set up. Right at the start of the project, all already known requirements of the system and its components comprising also test specifications shall be collected. Moreover, a continuous risk assessment is planned to get an idea of potential risks for the development. "WP2 Cell" deals with the ongoing development of metal supported SOFC (MSC) which is predicted to have significant benefits regarding mobile applications over anode or electrolyte supported SOFC. Aiming to improvement of the MSC cell performance, fundamental electrochemical characterization including impedance spectroscopy will be carried out. Additionally, the cell manufacturing strategy has to be adapted to the novel design with optimum quality level. Finally, process stability, manufacturing processes and their interactions have to be understood scientifically in order to allow a successful increase of manufacturing capacity.

The work packages "WP3 Repeat Unit" and "WP4 MSC Stack" is in the main focus of the planned project. The main tasks in these work packages are the integration of MSCs into a metallic repeat by laser welding and the assembly of these repeat units to a stack. The integration by laser welding requests extensive testing supported by simulation processes in order to minimize warpage without damaging the electrochemically active ceramic layers. The stack assembly demands suitable materials for optimum sealing and contacting as main tasks of the development. The joining strategy of the stack has to retrofit to the MSC and all used components and materials have to be developed. The overall performance of stacks as well as of single repeat units will be determined using different fuels and Operation conditions. "WP5 Stack Module" deals with the very important interface stack -system. The stack module has to fulfil different requirement: starting from adequate rigging of the stack and designing an optimum gas flow behaviour to the stacks up to thermal insulation of the entire module.

2nd main focus in the project is on the system that has to be developed from scratch to meet the requirements as following: high power density, high efficiency, capable for dynamic operation and quick start. All these requirements are far beyond state-of-the-art SOFC systems. They will be addressed using novel techniques, operation strategies and system architectures to allow the operation with ethanol-based fuels.

The necessary components will be designed and tested in hardware. Additionally the interface design to the integration into an electrical vehicle is another fundamental challenging aspect in the research activities towards a SOFC based range extender. "WP7 technology validation" is planned to show the principal feasibility of such range extender system in a vehicle as a technology carrier. Therefore, short tests in a real-world environment will be carried out to get a first Impression of its behaviour on board. The planned project "MeStREx" emphasises fundamental topics in R&D for a MSC based range extender system for electrical vehicles, surrounded by early product development methods, such as specifications build and technology validation. Key aspect of the undertaking is industrial research accompanied by

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#### Project coordination

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measures in the field of experimental development.