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J1Or1A-01: [Invited] Additive Manufacturing and hybrid materials in high power density machines for electric propulsion of vehicles

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The Climate change is the major challenge of this century. Thus, a carbon neutral and sustainable transportation sector could significantly reduce CO2-emissions and help to limit the global warming to a maximum of 1.5 degrees Celsius. For Siemens AG electric machines are a key technology to reach this ambitious goal. In combination with green hydrogen and fuel cells different areas of transportation such as aircrafts, ships, trains and trucks can be decarbonized. To improve the efficiency of electric machines or in special applications the power density, innovative designs and manufacturing methods are required. Therefore, additive manufacturing methods and hybrid materials are used to extend the freedom in design space and create improved electromagnetic parts and high-performance heat exchangers. To further increase the power density of electric machines up to 10 kW/kg a dual use of liquid hydrogen as energy storage and as cooling liquid is investigated. In the German S&G-Project "AdHyBau"a consortium of five partners investigates Additive Manufacturing methods and hybrid-materials in cryogenic environment and transfer these results to electric drive trains.

This paper presents a seamlessly integrated design- and simulation process for electric machines with high power density. Within this process we use numerical methods to create innovative solutions for coils and structural parts in a cryogenic environment of a hydrogen-hybrid electric drive train for vehicles such as ships, airplanes or trains. Some of these parts are built up as demonstrator and tested under laboratory conditions to validate the simulation process with experimental data.

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