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M1Or3G-07: [Invited] Fully Superconducting, Hydrogen-Cooled Motors for Electric Aircraft Propulsion

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The aviation industry is responsible for a small but rapidly growing proportion of the world's greenhouse gas emissions. One way to ameliorate this problem is by replacing hydrocarbon-based propulsion systems with electric propulsion systems. This approach requires storing energy in the form of batteries or liquid hydrogen. For large, commercial aircraft, batteries are currently untenable due to their relatively low power density. Hence, the Center for High-Efficiency Electric Technologies for Aircraft (CHEETA) is researching technologies needed for an all-electric commercial airplane with liquid hydrogen (LH₂) energy storage. One key enabling technology is superconducting electric propulsion motors. In the CHEETA airplane, the cryogenic LH₂ fuel could function as a coolant for the motors' superconducting components. Such motors have the potential to achieve high specific power and efficiency, though many technical challenges need to be overcome to achieve a practical design. These include ac losses in the superconducting armature winding, two phase cooling with liquid hydrogen, and fault handling and protection. Here we present a status update on the design and risk-reduction tests for a fully superconducting aircraft propulsion motor, as well as a broader project overview.

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