

## Small-Power Portable Solid Oxide Fuel Cell Systems

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Solid oxide fuel cells (SOFCs) offer important advantages, including low emissions, high efficiency even in small size systems, and fuel flexibility. Although proton exchange membrane fuel cells are considered the fuel cell of choice for portable and military applications, any CO in the fuel is a poisoning species for them. In contrast, SOFCs can use CO and other hydrocarbons as fuel, which makes them particularly attractive in certain portable applications. Challenges arising for SOFCs for portable applications are that the SOFC stacks must be light, have a short start up time, and be thermally-sustaining. Quick start up time is particularly crucial for portable applications; however, it is very difficult to achieve because of relatively low thermal shock resistance for ceramic components. In addition, the portability necessitates a novel balance of plant, which requires compact sulfur removal subsystem, fuel reformer, recuperator, air supply and power electronics.

Although both tubular and planar stacks have been utilized in portable SOFC demonstration systems, microtubular cells have been successfully demonstrated for small-power, portable applications. The benefit of microtubular cell design is its capability of tolerating many thermal cycles. In addition, microtubular cell design can provide reasonable volumetric power density, comparable to planar cell design. The power density increases inversely proportionally to the tube diameter. The challenges reside in applying electrodes and connecting the metallic contact inside the bore of a microtube. In this presentation, status of the portable SOFC systems and strategies to meet the aforementioned challenges will be reviewed and discussed.