Editorial: Solid-state conductors

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The technology of solid-state conductors has created a niche for itself in research as well as in application. With the limited reserves of fossil fuels that are estimated to last only for a few more years, it is essential to develop efficient energy-harvesting/storage systems utilizing renewable resources. Solid-state conductors are employed in these systems, and thus play a key role for sustainable development. For designing solid-state conductors, the charge-conduction process, as well as the mechanistic pathways associated with it, require a detailed understanding. This will enable promotion of electrical conduction phenomena in novel materials. The themed issue of *Nanomaterials and Energy* on 'Solid-state conductors' unveils the advances and challenges with respect to the conducting materials.

Solid oxide fuel cells (SOFCs) directly convert the chemical energy of fuels to electrical energy, and thereby offer fuel flexibility and superior electrical efficiency, as well as discharging lower quantities of greenhouse gases to the environment than the conventional power-generation modules. The anode carburization is one of the major issues around using hydrocarbon-based fuels. Kumar *et al.*¹ report the performance of cobalt-copper-yttria stabilized zirconia-gadolinia-doped ceria composite anode towards carburization. The study highlights the significance of the sintering/agglomeration process leading to the segregation of metal in the mixed metal anodes.

The high-temperature operation of the fuel cell may lead to the degradation of components and thereby pose a serious durability issue. The effect of high temperature on the oxidation/degradation of graphite has been reported by Ariharan *et al.*² Samples with

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varying degrees of graphitization were tested under different temperature domains. Higher oxidation resistance offered by the sample with lower graphitization and fewer active sites reflects the role of appropriate material selection.

Solid oxide electrolyser cells, which are regarded as the reverse of SOFCs, can be utilized for the generation of high-purity fuels by the application of electrical energy. Arunkumar and co-workers, in a paper titled 'Review of solid oxide electrolysis cells: a clean energy strategy for hydrogen generation',³ summarized hydrogen production through steam electrolysis. The developments in the oxygen-ion- and proton-conducting electrolytes are reviewed. In addition to various electrochemical processes occurring at the fuel and air electrodes, the article provides an insight into the key issues in the electrolysis mode of operation and the potential solutions for improving the durability.

We thank all the authors who contributed to the themed issue and provided glimpses of the latest development in solid-state conductors.

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