Durability of perovskite membrane materials and multilayer stack actuators

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Abstract

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Abstract Dense ceramic membranes with a perovskite structure can exclusively separate oxygen from air at high temperature. On this moment small scale units are applied for the production of pure oxygen. The operating conditions in these units are at temperatures between 800-1100 C and partial oxygen pressures of 1-1000 Pa. Under these operating conditions the mechanical stability of the perovskite-type membranes is affected by the expansion of crystal lattice with decreasing oxygen content. TNO analyses by microstructural and electrical characterisation the perovskite ceramic membrane materials before and after usage under operating conditions. The information from these characterisation is used for further material development of dense perovskite membranes. Multilayer stack actuators built up by PZT layers and Ag/Pd are used for actuation at room temperature. The effect of thermal treatment on the chemistry of PZT is analyzed at the grain boundary scale. Changes in grain boundary composition and nature are correlated with the thermal conditions. Next, the samples are subjected to slow crack growth experiments, and the chemical properties on the grain boundary scale are related to the mechanical properties of the material. The results show clear effects of lead content and lead distribution on mechanical behavior.