Solid Oxide Fuel Cells (SOFCs), as energy conversion systems that produce electricity by chemical reaction have great advantages compared to conventional energy systems due to their high conversion efficiency and environmental safety. Sc0.1Ce0.01ZrO2 electrolytes for Solid Oxide Fuel Cells are very promising materials for their high ionic conductivity in the temperature range 800°C-1000°C.

The vibration response of cubic and rhombohedral (β) 10 mol% Sc2O3 - 1 mol% CeO2 - ZrO2 Sc0.1Ce0.01ZrO2 ) both at room and high-temperatures is reported. The in-situ heating experiments and ex-situ indentation experiments were performed to characterize the vibrational behavior of these important materials. A temperature and stress-assisted phase transition from cubic to rhombohedral phase was detected during in-situ Raman spectroscopy experiments. While heating and indentation experiments performed separately did not cause the transition of the cubic phase into the rhombohedral structure and only broadened or strained peaks of the cubic phase could be detected, the heating of the indented (strained) surface led to the formation of the rhombohedral Sc0.1Ce0.01ZrO2. Both temperature range and strained zone were estimated by in situ heating and 2D mapping, where a formation of rhombohedral or retention of cubic phase has been promoted.

The mechanical properties, such as Young’s modulus, Vickers hardness, indentation fracture resistance, room and high temperature four point bending strength and SEVNB fracture toughness along with the stress - strain deformation behavior in compression, of 10 mol% Sc2O3 - 1 mol% CeO2 - ZrO2 (ScCeZrO2) ceramics have been studied. The chosen composition of the ScCeZrO2 has very high ionic conductivity and, therefore, is very promising oxygen ion conducting electrolyte for the intermediate temperature Solid Oxide Fuel Cells. Therefore, its mechanical behavior is of importance and is presented in this study.