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#04-82 Design of an acoustic sensor for fission gas release characterization devoted to JHR environment measurements.

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Among numerous research projects devoted to the improvement of the nuclear fuel behavior knowledge, the development of advanced instrumentation for in-pile experiments in Material Testing Reactor is of great interest. In the frame of JHR reactor, new requirements have arisen creating new constraints. This research is carried out within the framework of a long-standing partnership between CEA, CNRS and the University of Montpellier.

An acoustic method was tested with success during a first experiment called REMORA 3 in 2010 and 2011, and the results were used to differentiate helium and fission gas release kinetics under transient operating conditions. This experiment was lead at OSIRIS reactor (CEA Saclay, France). The maximal temperature during the irradiation test was about 150 ℃. In spite of the success of the experiment, it appeared necessary to optimize this type of probe especially the acoustic coupling. To overcome the problems encountered during the REMORA experience, we have developed thick film transducers produced by screen-printing process. They offered a wide range of possible application for the development of acoustic sensors and piezoelectric structure for harsh temperature environment measurements. We proposed a screen-printed modified Bismuth Titanate piezoelectric element on alumina substrate allowing acoustic measurements until high temperature.

JHR environment imposes a device maximal size and a working temperature of up to 350℃. This drives design choices.In this paper we will focus on the mechanical design of the new sensor. This acoustic sensor is composed of an acoustic element for generation and detection of acoustic waves propagating into a cavity filled with gaz. We will detail the choice of piezoelectric materials, the thickness of the different layers, the cavity shapes, the electrical connections, the means of assembly of the different parts. Theoretical and experimental results will be given. The evolution of the impedance response and the piezoelectric parameters of screen printed piezoelectric structures on alumina will be studied.

All that points will be discussed in term of acoustic sensor sensitivity versus dimensional constraints, in the case of a high temperature range working.

Keywords: Material Testing Reactor / Acoustic sensor / Gaz release / In-pile experimentation / High temperature

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