CO-90 01 1487/V7606 (2001-2011)

A co-operative project between Belgian Nuclear Research Centre (SCK/CEN) and Ultrasound Institute

High Temperature Ultrasonic Transducers for a heavy liquid metal environment

the objective of the project

In some nuclear reactors or accelerator driven systems (ADS) the core will be cooled by means of heavy liquid metal (HLM), for example, lead- bismuth eutectic alloy. For safety and licensing reasons an ultrasonic imaging system for visualization of the interior of the nuclear reactor MYRRHA (Belgian Nuclear Research Centre (SCK/CEN)) is under development. This system will exploit piezoelectric transducers submersed in the liquid lead-bismuth alloy.

development of high temperature ultrasonic transducers

Transducer operation conditions:

Submersed in liquid lead-bismuth alloy;
Temperature 130-450°C;
Exposed to liquid metal corrosion;
DLC coated protector.

High temperature bismuth titanate ultrasonic transducer with THERMOCOAX coaxial cable

Selection of piezoelectric materials suitable for operation at elevated temperatures and under strong radioactive irradiation:

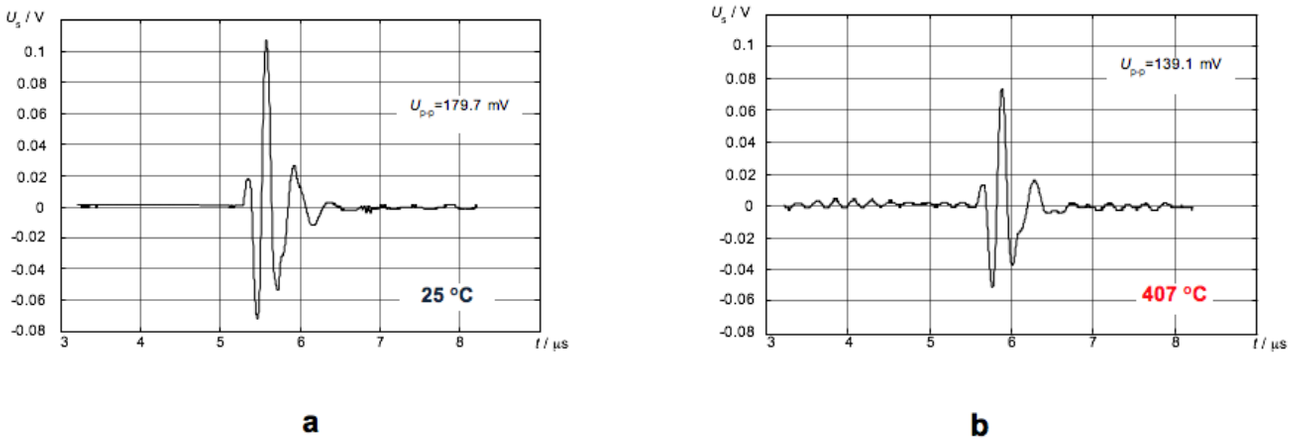
Piezoceramic bismuth titanate Pz46.

Acoustic coupling of a piezoelectric element to protector and backing at high temperatures:

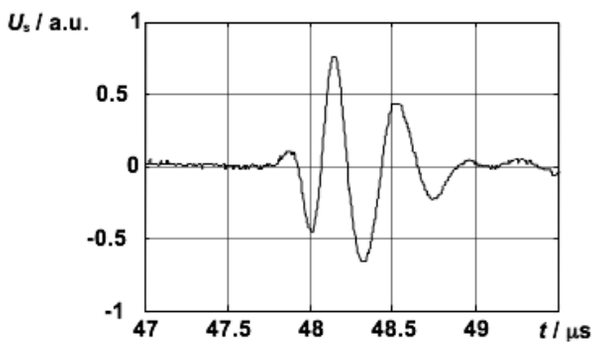
Thermosonic diffusion bonding.

Durable and stable acoustic coupling of an ultrasonic transducer to the liquid metal (Pb/Bi) alloy:

Diamond like carbon coating (DLC).



Pulse responses of the ultrasonic transducer at room (a) and high (b) temperatures



Ultrasonic signal experimentally obtained in a pulse- echo mode in a liquid Pb/Bi alloy (a.u.- arbitrary units)

related publications

1. R. Kažys, A. Voleišis, B. Voleišienė. High temperature ultrasonic transducers: review. Ultragarsas. 2008. Vol. 63. No. 2. P. 7-17.

2. R. Kažys, L. Mažeika, A. Voleišis, R. Šliteris, E. Jasiūnienė, H. Ait Abderrahim, M. Dierckx. Ultrasonic imaging in the liquid metals. International Journal of Applied Electromagnetics and Mechanics. Amsterdam: IOS Press. ISSN 1383-5416. 2007. Vol. 25. No. 1-4, p. 249-256.

3. R. Kažys, A. Voleišis, R. Šliteris, L. Mažeika, R. Van Nieuwenhove, P. Kupschus, H. Ait Abderrahim. High temperature ultrasonic transducers for imaging and measurements in a liquid Pb/Bi eutectic alloy. IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control. ISSN 0885-3010. Vol. 52. No. 4. 2005. p. 525-537.

4. R. Kažys, A. Voleišis, R. Šliteris, B. Voleišienė, L. Mažeika, P. Kupschus, H. Ait Abderrahim. Development of ultrasonic sensors for operation in a heavy liquid metal. IEEE Sensors Journal. ISSN 1530-437X. Piscataway: IEEE. 2006. Vol. 6. No. 5. p. 1134-1143.