



Abstract

Lead free sonar transducers for underwater acoustics

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Piezoelectric materials used for military applications, especially in underwater acoustics, are to a very large extent based on ceramics, more specifically, on lead titanate-zirconate $\text{Pb}_{1-x}\text{Zr}_x\text{TiO}_3$ (PZT). Civilian and military users now face challenges with European regulations regarding lead and its derivatives identified in the Candidate List of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation from 2012, with the risk of its inclusion in the Annex XIV (substances under authorization) in the coming years. This is a concern for sonar systems used in underwater applications utilizing piezoelectric ceramics.

In this context, the SCUALE project (Sustainable Components for Underwater Acoustics using Lead-free materials in Europe) financed by the European Defense Fund started in 2023 and aims to study, develop and produce advanced lead-free materials and components with improved performance to replace existing PZT ceramics for military underwater acoustics applications.

Our study aims at evaluating the performances of lead free transducers compared to current PZT based transducers. At ISPA 2024, we will present the synthesis of the finite element method modeling of one active and one passive lead free transducers with minor design updates compared to the PZT reference. For each transducer, we will compare the performance obtained with two lead free ceramics available at industrial scale (potassium sodium niobate KNN-based and barium titanate BT-based) to a reference PZT-4 transducer. The next steps of the project will be the realization and characterization of lead-free transducer prototypes along with the validation of the finite element method models.

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