

**CONCEPTUAL DESIGN OF ELECTROTHERMOMECHANICAL MICROACTUATORS
WITH FUNCTIONALLY GRADED METTALIC MATERIALS USING TOPOLOGY
OPTIMIZATION FOR RESPONSE TIME REDUCTION**

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Electrothermomechanical microactuators are essentially microactuators that move based on Joule heating, see e.g. [1,2]. Although they present some advantages, such as relatively low excitation voltages, the actuation time of an electrothermomechanical microdevice is essentially higher than the times related to other actuation principles, such as electrostatic and piezoelectric. In this work, functionally graded metallic materials are numerically evaluated in the context of the conceptual design of electrothermomechanical microactuators for response time reduction. Topology optimization is applied to design the microactuators, and the objective is to maximize the integral of the output displacement of the actuator, which is a function of time [2]. Gradation in only one direction is considered due to fabrication limitations, and Nickel and Copper are employed as base materials. Regarding the topology optimization method, Sequential Linear Programming and the Solid Isotropic Material with Penalization model are employed. Results for a cantilever microactuator model are presented. They show it is possible to reduce response time, at the expense of higher driving power. An optimized prototype has been fabricated based on spark plasma sintering to access the feasibility of the manufacturing process.

[1] SIGMUND, O. Design of multiphysics actuators using topology optimizaiton - Part I: One-material structures. *Computer Methods In Applied Mechanics And Engineering*, v.190, p.6577–6604, 2001.

[2] MELLO, L.A.M., SALAS, R.A., SILVA, E.C.N. On response time reduction of electrothermomechanical MEMS using topology optimization. *Computer Methods In Applied Mechanics And Engineering*, v.247-248, p.93–102, 2012.