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I-CReST 2025: 082-046 – Investigation of Nickel and Gold-based RF MEMS Creep Deformation: Simulation Approach Using NanoHub

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ABSTRACT

This study focuses on the investigation of the influence of beam dimensions and electrical parameters on creep deformation in radio frequency microelectromechanical systems (RF MEMS) fixed beam switches. For RF MEMS, creep is a time-dependent deformation that occurs under sustained stress on the structure and represents a significant issue in the long-term reliability of MEMS devices operating under continuous applied voltage. The RF MEMS simulation is performed using the nanoHUB to monitor the behaviour of the RF MEMS creep on a constant voltage of 20V with various structures where the beam thickness and initial air gap are varied. For the MEMS simulation, we focus on two materials, namely Nickel and Gold. The first investigation involved the variation of beam thickness from 1μm to 5.45μm, while keeping the initial gap constant. Whereas, in the second investigation, the beam thickness was kept constant, and the initial air gap was varied from 0.9μm to 5μm. The result from the first investigation shows that Nickel demonstrates the lowest deformation when the beam thickness was 2μm and the initial air gap was kept constant. The initial air gap is important as it determines the distance between the beam and the substrate, with shorter gaps leading to more deformation. In the second investigation, Nickel showed the lowest deformation when the beam thickness was constant, and the air gap was set to 2.5μm. This research indicates that beam dimensions play a larger role in the creep behaviour of one material. It can also be concluded from both results that the material selection affects RF MEMS creep, as both deformation shows Nickel creep much faster than Gold due to its highest RF creep. For future recommendations, it is recommended to include different types of materials in this study to enhance understanding of the materials in RF MEMS creep.

Keywords: RF MEMS; nanoHUB; Reep deformation; Beam dimensions; Applied volt