Introduction: Radio frequency (RF) micro-electro mechanical system (MEMS) switch works in on/off modes controlled by electrostatic forces. In off mode, rough surfaces of electrodes come into a contact to shunt the RF signal. Surface contact area has been recognized as a key factor in RF MEMS performance and reliability. Topography of the surfaces and contact mechanics determine the contact area. The capability to predict contact quality becomes extremely important to meet the challenges in RF MEMS applications.

Statistical Modeling and Contact Analysis of RF MEMS Surface
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Computational Methods: Atomic force microscopy (AFM) was used to record the bottom electrode surface for the multi-scale topography. Nested sampling plan
-- 60X60 μm² (1 sample)
-- 10x10 μm² (5 samples)
-- 1x1 μm² (27 samples)

Figure 1. Top view of RF MEMS switch and Schematic of work status

Results: Regular pattern is the first part that comes into contact as well as deforms plastically. The contact area grows slowly and nonlinearly at small interference, which would verify the existence of the regular pattern. While contact area increases rapidly and linearly at large interference, which may implies the fractal part starts to contact at certain point during the plastic deformation of regular pattern.

Conclusions: Regular-fractal structure on MEMS surface affect contact mechanics in different scales. The work is expected to replicate and explain the way that different regular patterns and fractal irregularity affect contacts between bumps and nano-scale asperities. Contact mechanics under cyclic loading/unloading behavior which mimics the electrostatic force is a promising study in the future.

References:

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