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Measuring the electrical breakdown of air for very small electrode separations EMMANOUEL HOURDAKIS, GARNETT W. BRYANT, NEIL M. ZIMMERMAN, National Institute of Standards and Technology — Understanding the basic principles of electrical breakdown in air for small electrode separations is becoming very important in the design and operation of microscale devices such as MEMS sensors and actuators. This work presents a new method [1] for measuring the value of breakdown voltage in air for electrode separations from 400 nm to 45 μm. The method consists of bringing 2 evaporated Au electrodes on sapphire together in a parallel plate geometry. Amongst the improvements of our method are the measurement of plate separation and the very small surface roughness (average of 6 nm). We demonstrate the ability to deduce the value of the separation of the plates by the value of the capacitance. We analyze the data for small separations, using the theory of standard field emission and field amplification on the surface of a conductor. We come to a prediction about the geometry and size of the electrode surface protrusions that would produce the observed emission. For the first time, we look for these predicted protrusions using an AFM. We find several reasons why the standard theory does not appear to explain our data.

[1] Rev. Sci. Instrum. **77**, 034702 (2006)

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