HIGH POWER, HIGH REPETITION-RATE WATER SWITCH

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The high dielectric strength of water (1MV/cm for distilled water[1]) makes it an attractive switching medium in high power, low inductance switches. For water switches which operate at voltages of ten's of kV, currents of less than 1 kA, and transfer energies on the order of J to the load at high repetition-rates (1 kHz) operation has been demonstrated[2]. Experimental studies on postbreakdown processes in static water switches have shown full dielectric recovery time of approximately 1 ms. The recovery process is determined by the formation of a vapor bubble, its expansion and decay. As demonstrated through electrical pulse-probe measurements, it is the vapor bubble, which prevents the water to recover its full dielectric strength. The recovery time is measured by means of a pulse-probe system that generates tow pulses with the first pulse to cause breakdown of the water, and the second pulse to measure the breakdown voltage at various times after the first pulse has been applied. This voltage is determined by the degree of the dielectric recovery of the water after the first breakdown. An effort to achieve a higher maximum repetition-rates (>1 kHz) of the water switch is made by using flowing water to remove the bubble rather than wait until the vapor bubble has decayed. Various methods of introducing the liquid into the volume between the electrodes have been explored. Of particular interest is an electrode geometry consisting of a hollow tube electrode facing a rod electrode. In this case water is injected axially, a method which should allow us to replace the critical switch volume between the electrode very rapidly. Results of pulse–probe experiments in water switches with this electrode configuration will be reported, and the consequences of these results on the design of high repetition rate liquid switches will be discussed.

1. S. Katsuki, S. Xiao, R. P. Joshi, M. Laroussi, and K. H. Schoenbach, "Electrical Breakdown of Sub-Millimeter Water Gaps", Conf. Record, 25th Modulator Symposium, Hollywood, CA, 2002, pp. 199-202.
2. S. Xiao, J. Kolb, S. Kono, S. Katsuki, R. P. Joshi, M. Laroussi, and K. H. Schoenbach, "High Power Water Switches: Postbreakdown Phenomena and Dielectric Recovery", submitted to IEEE Trans. Dielectrics and Electrical. Insulation.

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