

### **Study of RF Breakdown Mechanisms Relevant to an ICH Antenna Environment**

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The mechanisms that contribute to RF breakdown/arcing in an antenna environment are being studied. RF breakdown/arcing is a major power-limiting factor in antenna systems used for RF heating and current drive in fusion experiments. The factors that contribute to breakdown include gas pressure, gas type, magnetic field, materials, ultraviolet light, and local plasma density. The effects of these factors on RF breakdown are being studied in a resonant 1/4-wavelength section of vacuum transmission line terminated with an open circuit electrode structure. The electrode structure is designed to determine the role of the RF electric field strength and magnetic field orientation on the breakdown process. Changes in the electrical parameters, such as input impedance and the voltage at the electrodes, are being monitored to detect the breakdown events. Measurements of the light emission prior to and during an arc are also being made. For high vacuum conditions using copper electrodes, bright spots appear on the electrode surfaces prior to a breakdown event. An increase in the RF field results in an arc and a flash of light corresponding to copper line emission (578.2 or 521.8 nm). Analysis of the electrode surfaces show large areas of melting and formation of micron-sized rounded protrusions, especially along the sharp edges of small scratches. An increase in the chamber pressure results in a decrease in the maximum RF electric field that can be sustained without breakdown as the pressure approaches a few mTorr. The breakdown event leads to formation of a plasma in the structure, with light emission corresponding to the particular gas being used. The addition of an external magnetic field causes the formation of a plasma at lower pressures, thus limiting the amount of coupled RF power. Current experiments are focusing on the effect of the orientation of the magnetic field with respect to the RF electric field, as well as electrode material and UV light exposure. Experimental details, as well as future plans for studying arcing in an ITER-like multi-strap antenna, will be presented.

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