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Subtorr Operation of a Miniature Gas Ionization Sensor Based on Gold Nanowires

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Vertically aligned freestanding gold nanowires (AuNWs) were synthesized and deposited on one of the electrodes of a capacitor-like gas ionization cell, whereas the counterelectrode was a polished silicon wafer coated with aluminum on both sides. The field enhancement property of high-aspect-ratio AuNWs was employed to reduce the gaseous breakdown voltage (V_b) at room temperature. The device was characterized in low-pressure air, and tested in subtorr argon where it demonstrated a considerable reduction in V_b compared with uniform field conditions and with its earlier counterparts. The dependences of V_b and prebreakdown currents on the polarity of applied voltage were studied. A particle-in-cell/Monte-Carlo-collision (PIC/MCC) model for the device was also developed to simulate the breakdown process within the same pressure range in which measurements were carried out. The simulated V_b-P curve showed good agreement with the measured characteristics.

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