An Anaiysis of Plasma Copled Devices

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An analysis of plasma coupled devices (PCD) and its application to image sensing are presented in this paper.

PCD analysis consists of two steps: One step is the lumped analysis of the conductance transistor (CDT), which is the elment device of the PCD. The current dependency of the amplification factor and switching waveforms are explained successively. The other step is the analysis of plasma coupling between CDTs in a semiconductor substrate. The analysis shows that the plasma coupling effect is subjected to "Ohm's law in the peak point voltage." The proportional lumped parameter of Ohm's law is named "coupling resistance" which indicates the plasma coupling strength.

It was also evident that the plasma coupling effrct shows two different operation modes. One mode is "the electric field coupling mode" in which CDTs are coupled through the electric field in the semiconductor substrate. The other mode is "the charge coupling mode" in which CDTs are coupled by the charges accumulated around the CDT in the ON state.

From the analysis of the PCD scanner, it was shown that an asymmetric emitter structure and a comb-shaped base structure are effective for widening the operational margin of the PCD, and increasing the swatching speed of the CDT.

To show the feasibility of the PCD, a linear image sensor has been fabricated. In this sensor, a new type of photo transistor named "high-low junction gate transistor", or HIT is used as the photo sensor. The PCD is used as a scanner of the HIT array. The fabricated device has 512-bit HIT sensors in a 25 um pitch. The signal frequency is about 2 MHz.