A STUDY OF CHARACTERISTICS OF PLASMA-POLYMERIZED PYRROLE AND ITS APPLICATION ON FIELD-EFFECT TRANSISTOR

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The chemical structure and physical properties of plasma polymerized pyrrole(PP-Py) have been studied. Application of PP-Py to the insulated-gate field effect transistor(IG-FET) is suggested using its semiconducting property.

The plasma polymerization was carried out in a bell-jar type reactor. Discharging power of radio frequency(13.56 MHz) was fed to capacitive coupled inner electrode via impedance matching box. Deposition kinetics of plasma polymerization could be controlled by experimental parameter.

The chemical structure of PP-Py was systematically changed depending on the discharge power and the flow rate of monomer. The deposition rate of PP-Py increased with increasing the flow rate of monomer at a fixed value of discharge power.

From the FT-IR study, we found that the C=C and C=N stretching bonds of PP-Py were increased by the thermal treatment at 300℃ for 1 hour.

The optical band gap and the electrical conductivity of the PP-Py film was 2.4 eV and 2×10^{-9} S/cm respectively, and these values were

remarkably changed to 1.0 eV and 5×10^{-6} S/cm by the thermal treatment. From these results, we assumed that increase of unsaturation were responsible for the change of optical band gap and conductivity of PP-Py.

The sandwich type cells of Al/PP-Py/Au and Au/PP-Py/n-Si showed the rectification phenomena and photovoltaic properties. From the current-voltage characteristics of these cells, we found that PP-Py showed the ohmic contact with Au electrode, and revealed the rectification with Al electrode by forming Schottky barrier.

From the capacitance measurement using Au/PP-Py/n-Si cell, it was found that the charge accumulation layers on the surface of n-silicone were generated by the positive voltage applied to the silicone electrode.

The performance of FET using PP-Py as a semiconducting layer showed the characteristics of an enhancement-type FET.

The source-drain current was not increased when the positive bias voltage was applied to the gate electrode, and was increased linearly to the source-drain voltage and then saturated when the negative bias voltage was applied. The saturated source-drain current was increased in proportion to the gate voltage.

The field-effect mobility of PP-Py on the FET was around 1.1×10^{-4} $cm^2/V\cdot sec$, and the threshold voltage of FET was -1.2 volt.