Contribution ID: **80** Type: **Oral contribution**

Development of the micro pixel chamber based on MEMS technology

Wednesday, 14 October 2015 09:35 (20 minutes)

(1) The u-PIC (micro pixel chamber) is our original gaseous two-dimensional imaging detector made by PCB (Printed Circuit Board) technology. The pixel Cu electrodes of u-PIC with a pitch of 400 um are placed on a polyimide substrate. At present u-PICs are used as the TPC of the Electron Tracking Compton Camera (ETCC) which is being developed for MeV gamma-ray astronomy. In order to improve the accuracy of electron tracking, a position resolution of electron less than 100 um and the uniformity of the gain less than one percent are requested. However, for the present u-PIC, the accuracy of the pixel structure and its pitch are strongly limited from the limitation of the PCB technology. For that reason, we require new technology that can manufacture a fine pixel structure with an um accuracy. And we fond MEMS (Micro Electro Mechanical System) technology that may be satisfied with it. To study this MEMS u-PIC, a small (5 mm x 10mm) MEMS u-PIC has been developed, and the fundamental feature of it as a MPGD has been measured.
(2) MEMS u-PIC consists of Cu electrodes and Si substrate, SiO2 wafer, polyimide wafer with a columnar cavity. For improvement of insulation, there are SiO2 and polyimide wafer between the cathode electrode and substrate. We made 4 types of prototype MEMS u-PIC in order to study the behaviors of MEMS u-PIC. Parameters for them are thickness of SiO2 wafer, diameter of polyimide cavity and manufacturing process. We investigated characteristics of them with X-ray source (Fe-55, 5.9 keV) and gas of 1 atm, Ar/C2H6 (90%/10%).
(3) In this work, all of 4 types MEMS u-PIC sent out signal from both anode and cathode. By the experiment, we obtained the gain of 700–1800 with MEMS u-PICs when anode voltage is 500 V. In comparison with PCB u-PIC, the gain of MEMS u-PIC is smaller than that of present u-PIC. However, our simulation gas avalanche using Garfield++ suggests that a gain of MEMS u-PIC is twice higher than the gain of present u-PIC. In addition, MEMS u-PIC with SiO2 1 um has a lower gain and a bigger leak current than MEMS u-PIC with SiO2 10 um.
(4) Most of MPGDs are made by PCB technology. But the processing accuracy of PCB technology is about 10 um while that of MEMS technology is about 1 um. Because processing accuracy make energy resolution higher, we expect MPGDs based on MEMS to open the new way. This work research MPGD based on MEMS and shows the characteristics.
(5) We think deterioration of MEMS u-PIC gain against simulation data is caused by Si working as semiconductor near anode. Thus we guess that the thicker SiO2 wafer become, the higher u-PIC gain become. Additionally MEMS u-PIC have more robustness against the discharge and higher gain than that with thin SiO2 wafer. MEMS enable us to make SiO2 wafer thicker than current prototype, therefore we make the next MEMS u-PIC with 20 um or thicker SiO2 wafer. Considering this work, we develop the next MEMS u-PIC and study characteristics of MEMS u-PIC in more detail.

Primary author: Mr TAKEMURA, Taito (Kyoto Univ.)

Co-authors: Dr TAKADA, Atsushi (Kyoto Univ.); Dr TOMONO, Dai (Kyoto Univ.); Dr KUBO, Hidetoshi (Kyoto Univ.); Mr YOSHIKAWA, Kei (Kyoto Univ.); Dr MIUCHI, Kentaro (Kobe Univ.); Mr OTA, Kohei (Dai Nippon Printing Co., Ltd.); Mr ODA, Makoto (Kyoto Univ.); Mr IWAKI, Satoru (Kyoto Univ.); Dr SONODA, Shinya (Kyoto Univ.); Mr MIYAMOTO, Shohei (Kyoto Univ.); Mr KOMURA, Shotaro (Kyoto Univ.); Mr SAWANO, Tatsuya (Kanazawa Univ.); Mr KISHIMOTO, Tetsuro (Kyoto Univ.); Dr MIZUMOTO, Tetsuya (Kyoto Univ.); Mr

MOTOMURA, Tomohisa (Dai Nippon Printing Co., Ltd.); Prof. TANIMORI, Toru (Department of Physics, Kyoto University); Mr MATSUOKA, Yoshihiro (Kyoto Univ.); Dr MIZUMURA, Yoshitaka (Kyoto Univ.); Mr NAKAMASU, Yuma (Kyoto Univ.)

Presenter: Mr TAKEMURA, Taito (Kyoto Univ.)

Session Classification: Contributed talks

Track Classification: New Developments in MPDGs