Basic performance of hole-type MPGD with fine-pitch PEG3C

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A fine-pitch hole-type micropattern gas detector (MPGD) has been developed. The material is crystallized photosensitive etching glass (PEG3C) with a fine hole pitch made by HOYA Corp. A basic performance test of the hole-type MPGD with an individual hole diameter of 50 μm and a hexagonal array pitch of 70 μm was carried out with X-ray beams for a Ne (90%) + CF_4 (10%) gas mixture at 1 atm. A gain of up to 3×10^4 and an energy resolution of 21% were obtained for 6 keV X-rays. Excellent X-ray imaging capability was demonstrated. The characteristics of a sealed gaseous PMT with a bialkali metal and PEG3C were also investigated.

KEYWORDS: Micropattern gas detector, PMT, PEG3C

1. Introduction

Presently, one of the most popular and useful micropattern gas detector (MPGD) is the hole-type MPGD, as represented by the gas electron multiplier (GEM) [1]. Typically, a hole-type MPGD consists of a thin insulator sheet (0.05 – 2 mm thick) with a large number of small holes (0.01–1 mm diameter). A glass capillary is another popular hole-type MPGD [2–4]. The insulator is a lead glass or a Pyrex glass, and the holes are formed using the standard manufacturing process for a microchannel plate (MCP) or using a microblasting technique. The glass material of the MPGD has a high potential use for the development of sealed-type gas detector, because the low outgassing from the glass make it possible for the detector to operate with a good long-term stability [5].

One of the new challenging applications of MPGD is a gaseous photomultiplier tube (PMT) in combination with a photocathode with MPGDs [4]. The potential advantage of the gaseous PMT is that it can achieve a very large effective area with moderate position and timing resolutions. In addition, it can be easily operated under a very high magnetic field compared with the conventional vacuum-based PMT. Fine imaging is required in various fields, such as biological and medical sciences, high energy physics, and astrophysics. In the development of a gaseous PMT for visible light, a glass is a more suitable material for the MPGD owing to the low chemical activity of the bialkali metal than that of the material of Kapton used in GEMs. Recently, we have generated new interest in a hole-type MPGD with a crystallized photosensitive etching glass (PEG3C) developed by Hoya Corp [6]. At first, we fabricated a glass plate (GP) using PEG3C with a thickness of 150 μm, an effective diameter of 20 mm, and holes with a diameter of 100 μm and a pitch of 360 μm. The per-