A BLACK MATRIX phosphor for IPEM *

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IPEM (Ion Photon Emission Microscopy) is a new kind of Nuclear Microscopy recently invented at Sandia National Laboratories. It employs a broad low current ion beam impinging a sample, covered with a few microns of a fast, highly efficient phosphor layer. The light emitted at the single ion impact point is projected onto a single photon position sensitive detector, by using an optical microscope. This allows maps of the ion strike effects to be produced, effectively removing the need for a micro-beam, in certain situations. Early tests employing homogenous phosphor layers have shown a characteristic effect of light blooming at the impact point, which decreases the spatial resolution of the instrument. We have developed a structured phosphoric layer capable of reducing this effect. It consists of phosphor pads embedded in a micrometric metal grid, fabricated using proton beam lithography. The grid wires prevent the light to spread and provide a resolution equal to the grid spatial period. Proton beam lithography allows the fabrication of high aspect ratio, like 1 μm grid with 5 μm thickness, which is not obtainable with other techniques. This thickness is required for the phosphor to emit enough light to be detected when a single ion crosses it. A prototype with 3 μm period and 1 μm wires was fabricated. For that, we spun a Cu coated silicon wafer with 5 μm SU8 resist. The resist was then irradiated by a 2 μm 2.5 MeV proton micro beam and developed to give an array of “posts” 2 μm wide that was plated with Ni to produce a grid. The black matrix was then produced by depositing a high efficient phosphor into the grid. We also describe the “table-top” IPEM setup, employing a miniaturized Polonium alpha source and a Quantar position sensitive device, and quantify the ion detection efficiency and resolution.

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