SIMULATIONS OF SMALL-PORE MICROCHANNEL PLATES FOR FAST GATED X-RAY IMAGING AND SPECTROSCOPY OF HIGH-ENERGY DENSITY PLASMAS*

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This paper builds on work done at National Security Technologies and Sandia National Laboratories (SNL) over the past several years on the design and characterization of microchannel plate (MCP)–based fast gated x-ray imagers for use on the SNL Z machine. These cameras use 10-micron-pore MCPs, similar to the type used for spectroscopy and imaging applications at other facilities. To aid in the understanding of MCP behavior, we have developed a Monte Carlo simulation model for prediction of MCP response. The code contains a detailed physical model of the electron cascade and amplification process of the MCP that includes energy conservation for the secondary electrons, the effects of elastic scattering of low-energy electrons from the channel wall, and gain saturation mechanisms from wall charging and space charge. Our model can simulate MCP response for both static and pulsed voltage waveforms. Excellent agreement between the Monte Carlo simulations and laboratory measurements has been achieved. Here, we apply our simulation model to 2-micron-pore MCPs, which, while readily available from a variety of vendors, are not used in imaging applications. We investigate the DC and pulsed gain characteristics of such an MCP, with particular emphasis on dynamic range, temporal response, and spatial resolution. The results are compared to the predicted and measured characteristics of 10-micron-pore MCPs.

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