

应用于中子照相的热中子敏感微通道板

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Thermal neutron sensitive MCPs for neutron radiograph

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摘要

图/表

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摘要 介绍了中子成像探测技术的应用。由于直接在微通道板(MCP)玻璃中掺加中子灵敏核素可使MCP对热中子敏感,从而可将MCP事件计数成像探测器的优势成功地应用于以中子为探针的成像探测技术,本文开展了热中子敏感微通道板的研究。通过在MCP玻璃中掺摩尔百分比为3%的Gd₂O₃,并沿用MCP的制作方法,完成了直径为50 mm和106 mm的大面阵热中子敏感MCP的制作,并进行了基于这种大面阵热中子敏感MCP的中子事件计数成像探测器的中子成像实验。理论和实验结果都验证了掺摩尔百分比为3%的Gd₂O₃ MCP可取得对热、冷中子30%~50%的探测效率。最后,进一步介绍了目前开展的封装式热中子敏感MCP增强管的研制工作。基于掺Gd₂O₃的MCP增强管并经光学耦合到CCD或CMOS相机的紧凑混合传感器结构是实现高时空分辨能力的中子照相无损检测技术的有效途径。

关键词 : 中子照相, 中子相机, 中子敏感微通道板, 增强CCD, 增强CMOS-APS

Abstract : The applications of neutron radiograph were introduced. As adding directly neutron-absorbing atoms into Micro-channel Plate (MCP) glass would make the MCP sensitive to neutrons, and the advantages of a MCP event counting imaging detector would be successfully extended to the imaging detection technologies, this paper explores the thermal neutron sensitive MCPs. By adding directly 3 mol% ^{nat}Gd₂O₃ into MCP glass composition and using a conventional fabrication process, the large format neutron-sensitive MCPs with diameters of 50 mm and 106 mm were fabricated and the high efficiency event-counting thermal neutron imaging experiments were completed by using this Gd doped neutron-sensitive MCPs. The theory and experiments verify that this 3 mol% ^{nat}Gd₂O₃ doped neutron-sensitive MCP realizes the detection efficiency of 30%—50% for thermal imaging or cold neutrons. This work now is further proceeding to develop a sealed neutron sensitive MCP intensified tube, because the compact neutron camera based on a hybrid sensor configure via optical couple to a CCD or a CMOS camera is a promising approach to high temporal and spatial resolution neutron radiographic nondestructive test technology.

Key words : neutron radiograph neutron camera neutron sensitivity Micro-channel Plate(MCP) intensified CCD intensified CMOS-APS

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