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Functional degradation of CCD detector irradiated by millisecond pulse laser

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Abstract: Based on a combination of online experimental process detection and off-line experimental results measurement, an experimental system of a millisecond pulse laser irradiating a CCD detector was established, the interacting process between the millisecond pulse laser and the CCD detector was studied, and the formation of different damage effects was analyzed. The experimental results show that: the damage on the CCD detector firstly occurred in the color filter layer, and then extended along the depth direction. The damage sequence of the color filter layer was green, cyan, yellow and magenta color filters, and the color filters were discolored after irradiation. The damaged area from center to outside was green, cyan, burgundy and yellow in the video image; increased the laser energy density to completely destroy partial optical part, the photosensitive layer was exposed in the air, the white part appeared in the middle of the bluish green part in the video image. The connecting position between the exposed photosensitive layer and color filter layer was accompanied with heave and displacement; the changes on the optical part of CCD detector were composed of thermal damage and mechanical damage, and the changes on the electrical part of CCD detector mainly performed noise on the output signal and decrease on signal-noise ratio(SNR).

Keywords: CCD detector; functional degradation; CMYG color filters; thermal damage; mechanical damage

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1. Introduction

In recent years, the interaction between lasers and CCD detectors gradually got the attention of scholars, including the phenomena such as the degradation of the optical and electrical properties of CCD detector, the permanent failure and no signal output of CCD detector. Since the structure of CCD detector and different working modes of laser had serious impact on the damage research, the research results were confined to the damage on the CCD detector with a specific structure under a certain laser condition. Because of the high peak power and the difficulty in producing a plasma-shielding phenomenon, the millisecond pulse laser was used as the light source in laser damage research. In this paper, we focused on the ICX405AK CCD detector under millisecond pulse laser[1-2], ICX055AL[3-4], ICX055BL[5-6] and

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