A framing high-speed interferography with pulsed He-Ne lasers

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A device of framing high-speed interferography for studying fast and transient phenomena in transparent media has been constructed and applied successfully. It is consisted of a pulsed He-Ne lasers source, an interferometer with shock-proof structure and a high-speed camera.

A series of interferograms have been obtained by using the device which can be used widely for flow visualizations of supersonic wind-tunnel, combusition, explosion and for interaction of high-power laser with matter etc., because it has simple shock-proof structure and operates so normally.

In present research we first suggest a method, by which an ordinary cw He-Ne lasers was operated inversely to obtain a time-controllable pulsed light source.

In this device we have used a plane-shearing interferometer which has only one interference element. The view-field of interferometer was greater and the cost was less than the others. It is easy to adjust and maintain.

The optical match of a rotating mirror high-speed camera with an interferometer which has a size of view-field about 120 mm in diameter has been described and optical films were applied to intensify the interference fringes. The difficult problems of synchronization among the transient phenomena, the pulsed He-Ne lasers and the rotating mirror high-speed camera have been solved. Therefore this device has been perfected and cooperated with rotating mirror framing high-speed camera and 1 mw pulsed He-Ne lasers to obtain a series of framing high-speed interferograms with exposure time 1.3μs per frame.

The interferometer is able to cooperated with different kinds of high-speed cameras as well.

This device has been applied to the flow-visualization of GDL under intense vibration condition, the pulsed high-power TEA CO_2 lasers to ignite air breakdown, the shock wave in air and the interaction of laser with targets.

Doens of interferograms of developing process under investigation was taken in one test.

Thus, the effective means for investigation on fast and transient phenomena are provided.

In this paper over 10 pictures of test will be given.

用 He-Ne 激光源的分幅高速干涉摄影

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用于研究在透明介质环境中发生的快速、短暂现象的分幅高速干涉摄影装置已研制成功，并得到应用。它是由脉冲 He-Ne 激光源、抗强振动的干涉仪与高速摄影机三部分组成。装置的结构简单、抗振、工作正常，能广泛地用于超音速风洞流场显示、燃烧、爆炸及强激光与物质相互作用等的研究中，能得到一系列清晰的干涉照片。

在研制中，首次提出了逆程序运转方案，将连续输出的 He-Ne 激光器成功地改造成时间可控的脉冲光源。

装置中用到了平晶型激光错位干涉仪。这是一种只有一块干涉元件的仪器，成本低，能获得比一般干涉仪大的视场。并且易于调整维护。

在研制中，还成功地解决了用光学膜来提高干涉光束强度的技术。讨论了转镜高度摄影机与具有 120 毫米直径视场的干涉仪之间的光学匹配，并解决了脉冲 He-Ne 激光源、短暂研究现象及高速摄影机三者间的时间同步，完善了整个装置。与转镜分幅高速摄影机配合，仅用 1 毫瓦改制的脉冲 He-Ne 激光器，得到了一系列分幅高速干涉照片，每幅曝光时间 1.3 微秒。其中干涉仪也可与其它类型高速摄影机配合使用。

该装置已用于 GDL 光腔流场显示、脉冲 CO_2 激光击穿空气、冲击波及激光与靶材的相互作用的研究中。能在一次试验中同时取得数十幅研究现象发展过程的干涉照片。这对快速、短暂现象的研究，提供了有效的测量手段。文中将提供多幅试验照片。