

光学工艺

超薄镜破坏阈值的研究

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摘要 新一代空间相机的非球面主镜由一些超轻超薄的分块镜组成, 由于目前通用的空间光学反射镜材料非常有限且大部分均为脆性材料, 在力的作用下产生强制性的变形将引起镜体大的应力甚至破碎, 所以必须研究超薄镜的破坏阈值。首先将弹性力学中应力强度因子的概念引入主动光学中, 证明了应力强度因子即传统意义的材料破坏阈值。提出材料表面的微裂纹是材料脆性断裂的根本原因。介绍了一种计算材料应力强度因子的方法。最后针对超薄平面镜模型进行了实例计算, 得到了超薄镜的破坏阈值与其尺寸、厚度、支承条件、表面粗糙度之间的关系。

关键词 [非球面镜](#) [弹性力学](#) [应力强度因子](#) [破坏阈值](#) [超薄镜](#)

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Damage threshold of ultrathin mirror

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Abstract The aspheric primary mirror of new generation space camera is made up of some ultrathin segments. Since the mirror is ultrathin and the material of the mirror is brittle, it will be broken easily if the force exerted is not proper. Therefore, the damage threshold of ultrathin mirror should be studied. The concept of stress intensity factor in elasticity was applied to active optics and stress intensity factor was proved to be the material's damage threshold. It is put forward that microcrack in the material is the major reason for breaking. A method to calculate stress intensity factor is introduced. At the end, the model of an ultrathin flat mirror was actually calculated, the relation between the damage threshold and the size, thickness, mounting and roughness of ultrathin flat mirror was achieved.

Key words [aspheric mirror](#) [elasticity](#) [stress intensity factor](#) [damage threshold](#) [ultrathin mirror](#)

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