Synopsis of “Strain-free mounting techniques for metal mirrors”

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CNC machining and diamond turning are becoming increasingly common and affordable. The availability of these machining techniques makes the use of metal mirrors more reasonable for optical and solar energy applications. This paper discusses a few simple design considerations, which take advantage of the metal properties to make strain-free mounts for the metal mirrors. The ability to incorporate mounting hardware into the mirror it’s self, can be advantageous from a cost and weigh reduction standpoint. This paper would be relevant to anyone considering metal mirrors for an optical application where a tight tolerance is desired. There are many other papers that cover kinematic mounting, but most are concerned with glass optics, or deal either with very small or very large mirrors. This paper addresses the unique properties of metal mirrors, and could be applied to making mirror segments that would make up mid-sized mirrors.

The paper is basic, and is not meant to provide an end design. Rather it provides a set of guidelines that can be used early on in the design process. These guidelines should help cut down the number of iterations between simulation and design modification, and help to produce a better end product. There are four basic design principles to be followed when trying to achieve stress free mounting of metal mirrors. They are as follows;

1) Isolate the mounting strain path form the mirror surface
2) Insure that the mirror is stiffer then the mount
3) Develop the surface figure for the mirror in the same strain condition as the final mount
4) Insure the mounting surfaces are held to the same tolerance as the surface figure

One of the problems with mirrors and mounts is coupling the surface to the structure. A lot of work goes into creating a mirror surface that has the right geometry and surface finish for the performance of the particular application. Then the mirror has to be mounted to a structure that is sufficiently stiff to provide the same performance. Theses four simple design practices can help designers make metal mirrors that will perform well, because the precise mirror surface will not be deformed when it is mounted to the stiff structure.

Applying these design principles will help designers make the most out of the metals material properties. Furthermore, it is possible that these same principles could be applied to other materials such as cast metals, and plastics. This could further drive down the cost of optics that sill perform well. The availability of precision machining equipment can only take things so far. Good design practices are still necessary to get the most out of what the equipment has to offer. It is thought the application of papers like this one that designers will be able to use the tools available to them to make better products.