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"Omega-type" Coating on Aluminum Foil

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1 The need for thin aluminum foil

It has been recognized that it is difficult and expensive to apply a multi-layer dielectric coating to the inside of an aluminum light concentrator. Omega Energy's attempt to put an Omega-mirror finish on the inside of a Harjohn cone was not successful; they merely succeeded in reducing the reflectivity by about 10%. Therefore it is proposed to coat flat aluminum sheet (cost US$4 per square foot) and then use it to form a cone. The sheet has to be very thin for the following reasons:

- To keep the backgrounds induced by radioactive traces in the aluminum to a tolerable level.
- To allow the aluminum to be formed into a concentrator without inducing stress in the optical surface which would reduce its performance and life-expectancy.

The radioactive constraints have not been fully evaluated but may require that the aluminum be less than 0.5mm thick. The stress requirements may be more severe: <0.1mm.

2 Omega Energy

The suppliers of Omega Mirror, Omega Energy, have been reluctant to attempt to coat sheet any thinner than 0.3mm. This is the thinnest their suppliers, Alanod and Mettaloxyd, produce. They are currently experimenting with this material. At least we are certain that is has the same optical properties of the regular 0.5mm sheet used for Omega Mirror.

3 Bob Parson's work at UBC

Just before Christmas Bob Parson's produced some "Omega-like" coating on a small piece of regular Reynolds 1 thou (.025mm) aluminum foil.

The coating was as follows:

- 50nm Aluminum Oxide (for adhesion)
- 300nm Aluminum
- 100nm Aluminum Oxide (n=1.4 at 450nm)
- 100nm Zirconium Dioxide (n=2.2 approximately)

This combination was chosen because it can be laid down entirely by sputtering, which is a more straightforward process than the e-beam method chosen by Omega Energy. The zirconium dioxide is a well understood sealant, like Omega's titanium dioxide, but it is easier to preserve the high refractive index of the bulk material. This is hard with titanium dioxide; the top coat of Omega Mirror was found to have an index of only 1.97. The index of aluminum oxide is slightly less than Omega's magnesium fluoride.

The formulae of Hass (J. Opt. Soc. Am. 45 p.945 1955) give the peak reflectivity of Parson's coating to be 94.5% in water (compared to 93.5% for Omega).