Scope

The two ends of the fibre ribbons need to be machined to high optical quality in order to maximize transmission and minimize diffusion. The non-read end needs to be mirrored to increase the light yield particularly for those photons produced close to this end where the radiation load is the highest.

Activities

Work is under way at Imperial College (IC) and at CERN

- IC: study ways of cutting the fibres with a diamond saw (M. A. Mccann)
- CERN: mirroring studies (C. Joram and T. Schneider)

Mirroring studies

Three different mirroring methods are being investigated

- direct vacuum coating of an Aluminium thin film reflector layer on the machined fibre end
- attachment by means of optical glue of a thin mirror, consisting of a thin Aluminium film on a mylar foil or thin glass substrate
- attachment by means of optical glue of a 3M ESR (Extended Specular Reflector) foil

A first series of tests has been carried out on Polystyrene scintillator pieces over a large wavelenth range allowing to measure specular and diffuse reflectivity separately. Prior to coating or gluing the mirrors, the scintillator surface was machined by a diamond single point tool as it is also considered for the machining of the fibre ends. A reference sample was left unmachined as provided by the supplier. The preliminary results clearly favour the 3M ESR foil which results in reflectivity values above 90%, followed by the mylar and glass mirrors. The directly coated film leads to the worst result, showing also a very significant fraction of diffuse reflection.

In a second step, the three methods will be tested on SciFi fibre samples in a realistic configuration. To avoid possible influences from cladding light or helical paths, fibres of 60 cm length are embedded in a plexiglass substrate (similar to the one used for the irradiation tests). The fibre ends will be machined and the different mirror techniques will be applied. Results can be expected on a time scale of about 1 month.

Diamond saw studies

The possibility of using a diamond saw to machine the fibres is being investigated without using additional support structures. The aim is to minimise the material used in the detector, and to produce a machining method that is quick and well suited to mass production.

Currently the technique is showing promise, with no drop in transmission compared to the surface recieved from Aachen (It is unknown how this surface was produced or how high quality it is considered), with a sensitivity in region of 1%. Despite visible machining marks the surfaces have reasonable quality, it needs to be established is the machining marks have any effect and if it is possible to minimise them. The measured transmission is also replicable with subsequent cuts.

This technique needs to be compared to surface produced with single-point diamond turning.

Short term investigations (aim for completion: before end of July):

- Microscopic inspection of surfaces to determine how visible cutting marks change with cutting speed and feed rate. Qualitatively assessing the cutting marks on surfaced produced using following parameters:

    - Cutting speed: 750, 1000, 1500, 2000, 2500, 3000 RPM @ Feed rate 750 mm/min.
    - Feed rate: 500, 600, 700, 800, 900, 1000 mm/min @ Cutting speed 1500 RPM.
- Determine transmission of surfaces produced with the "best" and "worst" set of parameters to evaluate whether cutting marks are a major issue.

Longer term:

- Compare to a reference surface, produced with single point diamond.
- Determine how well the surfaces can be mirrored, and the subsequent reflectivity.
- Quantify the reproducibility of the surface.

This topic: LHCb > SciFiDemoFibreMachMirr
Topic revision: r4 - 2013-07-16 - MichaelMcCann