What are the Future Technical R&D Plans for eWaterTek?

The future lies in the integration of opto-electronics as applied to fluorescent detection. Tackling the problems of developing optical interface coupler technology, i.e., coupling light into an optical fiber is also an important factor. In one case, we have the problem of coupling into multimode fibers, where the ray optics of the previous section can be used. In the other case, coupling into single-mode fibers, we have a fundamentally different problem. One must consider the problem of matching the mode of the incident laser light into the mode of the fiber. This cannot be done using the ray optics approach, but must be done using the concepts of *Gaussian* beam optics.

Generally, coupling light from a well-collimated laser source into multimode fiber is not a difficult problem. If the user assures that the maximal ray of the focused beam is well within the fiber, then effective coupling will be accomplished.

When we need to couple laser light into a single-mode fiber, we move from the ray optics picture in which we have worked to this point, to a *Gaussian* mode-matching problem. The subject of *Gaussian* laser beam optics is reviewed starting with *Gaussian* Beam Optics. This application is included here for completeness in discussing coupling light into optical fibers.

From a technical standpoint, in order to couple light of wavelength l from a collimated laser beam of 1/e2 diameter D into a fiber of mode field radius w, choose a lens with a focal length: **f = D(pw/4l)**

Considering the situation where we use a fiber coupler to couple light from a laser (l = 633 nm, D=1.2 mm) into a fiber (w=4.3 μm), we find f = 6.4 mm. For this application, use the objective, f=9 mm, as the closest fit to the correct focal length.

The coupling efficiency depends upon the overlap integral of the *Gaussian* mode of the input laser beam and the nearly-Gaussian fundamental mode of the fiber. This overlap integral is the same whether the input mode is the larger or the smaller of the two modes.

Developing this cutting-edge technology is part of the Phase II project, and applying for further (divisional) patents will come in due time.